FINAL

PHASE I REMEDIAL INVESTIGATION REPORT APPENDICES (VOLUME II OF III)

CROYDON TCE SITE BUCKS COUNTY, PENNSYLVANIA

> AUGUST 1988 W.A. NO. 124-3LM7

FINAL

PHASE I REMEDIAL INVESTIGATION REPORT

APPENDICES VOLUME II OF III

CROYDON TCE SITE BUCKS COUNTY, PENNSYLVANIA

EPA WORK ASSIGNMENT NUMBER 124-3LM7
UNDER
CONTRACT NUMBER 68-01-7250

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FINAL

PHASE II RI/FS WORK PLAN

APPENDIX A

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A.1.0 INTRODUCTION

NUS Corporation (NUS), under contract to Ebasco Services Incorporated (EBASCO), is pleased to submit this Final Phase II Work Plan for the Croydon TCE Site Remedial Investigation/Feasibility Study (RI/FS) to the U.S. Environmental Protection Agency (EPA). Preparation of this Work Plan was accomplished in response to Work Assignment Number 124-3LM7 under EPA Contract Number 68-02-7250 pursuant to the Final Phase 1 RI/FS Work Plan dated August, 1987.

During the scoping of the Phase I Croydon TCE Site RI/FS, limited data were available on the extent of a known volatile organic contaminant plume and potential sources of groundwater contamination within the Croydon TCE Site study area. Consequently, the RI/FS was conducted in two phases.

The Phase I RI/FS focused on identifying potential contaminant source areas, characterizing groundwater contamination within the study area, defining the extent of the contaminant plume, and assessing the public health risks of those residents who depend on groundwater as a source of potable water. The results of the Phase I RI/FS are presented in the Croydon TCE Site Phase I RI Report.

If, upon evaluation of the Phase I RI results, additional data were required to define and remediate identified potential sources of contamination, or to determine the extent of contamination in groundwater, a Phase II RI/FS would be conducted. Based on data obtained during the Phase I RI/FS, a Phase II RI/FS is required to meet the project objectives. This Work Plan outlines the Phase II RI/FS activities.

This Final Phase II RI/FS Work Plan describes the scope of work, resources, and budget necessary to collect the additional data (1) define the extent of the contaminant plume required to: identified during the Phase I RI; (2) to evaluate the identified sources of groundwater contamination; adequately assess and confirm the present and potential health and environmental risks; and (4) to evaluate the feasibility of potential remedial alternatives for the Croydon TCE Site. methodology and approach used to establish the project objectives and the Phase II RI/FS scope of work follow the latest EPA and REM III guidance for planning and implementing a remedial investigation and feasibility study. This guidance is based on the requirements of the Superfund Amendments and Reauthorization Act (SARA) of 1986, which emphasizes the RI/FS "scoping process" and a phased RI and FS.

This Work Plan focuses on the scoping of the Phase II RI/FS and the tasks required to implement the RI/FS. Because the Phase 33 RI Report provides detailed information on the site background, the Phase I analytical data, and the Phase I public health and environmental assessment, sections of the Phase I RI Report have been referenced in this Work Plan as appropriate.

The Phase II RI/FS Work Plan consists of six sections, including this Introduction (Section A.1.0). Section A.2.0, Site Background Information, references the Phase I RI Report. Section A.3.0 outlines the scoping of the Phase II RI/FS and defines the Phase II RI/FS objectives.

Eight tasks have been identified to conduct the Phase II RI for the Croydon TCE Site. Section A.4.0 of this report defines these tasks. The FS tasks (9 through 12) are provided in Section A.5.0. Project management activities, including the project organization, quality assurance and data management, schedule, and cost estimates are provided in Section A.6.0.

A.2.0 SITE BACKGROUND INFORMATION

The site background information, including a site description, the site history, and information on site geology, hydrogeology, and surface water hydrology is provided in Sections 2.0 and 3.0 of the Croydon TCE Site Phase I RI Report.

A.3.0 SCOPING OF THE PHASE II REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

The overall project goals for the Croydon TCE Site RI/FS are to determine the nature and extent of the threat posed by the release of hazardous substances and to evaluate alternatives for remedying the site problem(s). The overall objective of the RI is to collect the necessary data to determine the distribution and migration of contaminants, identify cleanup criteria, and identify and support the remedial alternative evaluation. The objectives of the FS are to develop and evaluate the remedial action alternatives with respect to protection of public health and environment, compliance with Applicable or Relevant and Appropriate Requirements (ARARs), and a reduction of contaminant mobility, toxicity, and volume.

Because only a limited amount of information was available for the study area and the source(s) of the TCE groundwater contamination was unknown, a two-phased RI/FS was proposed to gather sufficient information to meet the project goals. Phase I RI/FS objectives were subsequently identified and are outlined on Table 2-1 in the Phase I RI Report. Criteria for meeting these objectives were also established and are also given in Table 2-1. The REM III Project Team then identified the various investigations and data collection activities that are necessary to meet the criteria. (These are also given in Table 2-1.) The scope of work conducted under the Phase I investigation is described in Section 2.0 of the Phase I RI Report.

For the most part, the Phase I objectives have been satisfied. One of the criteria for performing a Phase II RI centered on the identification of potential source areas during the Phase I RI. Based on the findings of the Phase I hydrogeological

investigation, the TCE plume appears to be emanating from either Potential Source Area No. 1 or Potential Source Area No. 3b, which are located just north of U.S. Route 13. (See Figures 4-1 and 4-2 in the RI Report.) Therefore, this area will be the focus of study during the Phase II RI/FS.

The scoping of the Phase II RI/FS began after receipt, review, and evaluation of the Phase I data. As mentioned above, one reason for conducting a Phase II RI is to assess potential source areas that may be contributing to groundwater contamination. This Phase II study will focus on doing that. However, other studies related to confirming or supporting the Phase I findings and conclusions will also be performed. Some of these studies are primarily related to eliminating "Phase I" data limitations.

One such data limitation concerns groundwater flow and contaminant transport south of River Road. This area, which was not a part of the Phase I study area, will be included during the Phase II RI in order to assess whether another plume of TCE (emanating from the Bristol area) is migrating and combining with the Croydon TCE plume. Therefore, the Phase II study area has been expanded to assess groundwater flow direction and contaminant transport east of Route 413 and south of River Road.

The Phase II RI/FS has identified five objectives as shown on Figure A.3-1. The remainder of this Work Plan describes the Phase II scoping activities (i.e., review of existing data, identification of risks and data limitations, identification of potential remedial alternatives, etc.) and the proposed scope of work for the Phase II RI/FS.

A.3.1 SUMMARY OF EXISTING DATA

Please refer to Section 4.0 of the RI Report.

A.3.2 RISK ASSESSMENT

Please refer to Section 5.0 of the RI Report.

A.3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

One of the primary concerns in the development of remedial action alternatives for sites governed by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the degree of public health or environmental protection afforded by each remedy. EPA policy states that in the process of developing and selecting remedial action alternatives, primary consideration should be given to actions that attain or exceed Applicable or Relevant and Appropriate Requirements (ARARS), as defined by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Superfund Amendments 5 and Reauthorization Act (SARA). The purpose of this

FIGURE A.3-1 PHASE II RI/FS SCOPING DIAGRAM . CROYDON TCE SITE

PROJECT GOAL

Determine the nature and extent of the threat posed by the release of hazardous substances and evaluate alternatives for remediating the site problems.

SUNMARY OF PROBLEM

- Groundwater and surface water in the community of Croydon are contaminated with various organic and inorganic compounds at levels which exceed health-based ARARs.
- 2. Groundwater is used as a source of potable water by some residents of the study area.
- The source of groundwater/surface water contamination is unknown; however, a source area is suspected.
- 4. Another TCE plume may be migrating onto the study area from an offsite source.
- 5. Low levels of PCBs, unrelated to the groundwater contamination, were detected in all soil samples.

OVERALL RI OBJECTIVES

Collect the data necessary to determine the distribution and migration of contaminants, identify clean-up criteria, and -identify and support the remedial alternative evaluation.

OVERALL PS OBJECTIVE

Develop and evaluate the remedial action alternatives with respect to protection of public health and environment, compliance with ARARS, and a reduction of mobility and/or toxicity.

Based on the site problems, a two-phased RI/FS is necessary to meet the project goals and objectives.

PEASE I RI/FS OBJECTIVES

- Characterize the nature and extent of groundwater contamination detected within the southeastern portion of the study area.
- Assess the public health and environmental risks posed by groundwater within the study area.
- Determine the quality of local surface water in order to estimate the impact from groundwater discharge and estimate health and environmental risks associated with the use of these waters.
- Identify potential source areas that may be contributing to the groundwater contamination which is present within the southeastern portion of the study area.

PHASE I FINDINGS

- Plume boundary is relatively defined.
- 2. Residential wells in the focused area of investigation have exhibited levels of TCE above ARRS.
- 3. Low levels of TCE (<10 ug/l) detected in East Branch of Eog Run Creek and Eog Run Creek.
- 4. Potential Source
 Areas No. 1 and 3b
 are suspected,
 based on findings
 of the
 Hydrogeologic
 Investigation.
- Investigation.
 5. Low-level PCBs and
 PABs detected in
 soil samples from
 three locations.

- DATA LIMITATIONS
- la. Morthern boundary needs to be confirmed.
- lb. Assess possibility
 that another TCE
 plume is migrating
 into the study
 area from an
 offsite area east
 of Rt. 413.
- None-confirm Phase I results.
 Delaware River
 - needs to be sampled along with an intermittent stream north of Potential Source Area No. 1.
 - Delineate and characterize source area.
- . Source of PCBs and PABs is unknown. Collect background soil data to evaluate significance of Phase I results.

PHASE II RI/TS OBJECTIVES

- Investigate Potential Source Areas No. 1 and No. 3b to determine whether these areas are contributing to the TCE groundwater contamination on site.
- Define the northern boundary of the TCZ plume.
- Characterize the hydrogeology of the focused area of investigation south of River Road.
- 8 Confirm pubic health risks posed by the use of groundwater within the study area.
- Confirm the presence or absence of PCBs and PAHs in soil.

requirements to make CERCLA response actions consistent with other pertinent Federal and state environmental requirements.

SARA defines an ARAR as

- Any standard, requirement, criteria, or limitation under Federal environmental law.
- Any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than the associated Federal standard, requirement, criteria, or limitation.

Applicable requirements are Federal public health environmental requirements that would be legally applicable to a remedial action if that action was not undertaken pursuant to For example, if hazardous - waste activities were CERCLA. undertaken pursuant to an approved permit, applicable regulations would be available to legally define the required remedial action for site closure. Relevant and appropriate requirements are Federal public health and environmental requirements that apply to circumstances sufficiently similar to those encountered at CERCLA sites, where their application would be appropriate although not legally required. In addition, SARA now requires that state ARARs be considered during the assembly of remedial alternatives if they are more stringent than Federal EPA has also indicated that "other" criteria, advisories, and guidelines must be considered in devising remedial alternatives. Examples of such "other" criteria remedial alternatives. Examples of such "other" criteria include EPA Drinking Water Health Advisories, Carcinogenic Potency Factors (CPFs), and Reference Doses (RfDs).

Section 121 of SARA requires that the remedy for a CERCLA site must attain all ARARs unless one of the following conditions is satisfied: (1) the remedial action is an interim measure where final remedy will attain the ARAR upon completion; (2) compliance will result in greater risk to human health and environment than other options; (3) compliance technically impracticable; (4) an alternative remedial action will attain the equivalent of the ARAR; (5) for s requirements, the state has not consistently applied state requirement in similar circumstances, or (6) compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Fund money for response at other facilities (Fund-balancing).

In addition to governing response actions at a site, ARARS may also dictate other aspects of the RI/FS. For example, standard analytical methods may be inadequate to indicate compliance or exceedance of the ARAR. Therefore, it is often necessary that ARARS be considered during the specification of chemical—analytical methods. In light of the RI/FS process, ARARS Unit) be considered during the following: (1) Scoping of the Field Investigation (Task 1); (2) Risk Assessment (Task 6);

(3) Remedial Alternatives Screening (Task 9), and; (4) Remedial Alternatives Evaluation (Task 10).

ARARs fall into three broad categories, based on the manner in which they are applied at a site. These categories are as follows:

- Contaminant Specific These ARARs govern the extent of site cleanup. Such ARARs may be actual concentration based cleanup levels or they may provide the basis for calculating such levels.
- Location Specific These ARARs are considered in view of natural or man-made site features. Examples of natural site features include wetlands, scenic rivers, and floodplains. Man-made features could include, for example, the presence of historic-districts. ARARs based on aguifer designations are also location-specific ARARs.
- Action Specific These ARARs pertain to the implementation of a given remedy. Examples of actionspecific ARARs include monitoring requirements, effluent discharge limitations, hazardous waste manifesting requirements, and occupational health and safety requirements.

Tables A.3-1 and A.3-2 present a preliminary list of Federal and State ARARs for the Croydon TCE Site Phase II RI/FS, respectively. The ARARs are presented based on the category in which they fall. The rationale for the inclusion of each ARAR is provided in the tables. The ARARs identified in Tables A.3-1 and A.3-2 will be refined and revised, as necessary, as the RI/FS proceeds. A description of these ARARs is provided in the following paragraphs.

Additionally, Table A.3-3 presents a listing of concentration-based ARARs for the monitoring well and residential well contaminants of concern identified during the Phase I RI. These ARARs are also discussed below.

Federal ARARs

- Resource Conservation and Recovery Act (RCRA) of 1976
 (Amended 1984) Governs the generation, transportation,
 storage, and disposal of hazardous wastes. RCRA 40 CFR
 Part 264 standards are used for remedial actions
 including offsite hauling and disposal of hazardous
 wastes, onsite capping and landfilling, and groundwater
 monitoring.
- <u>Safe Drinking Water Act</u> The Safe Drinking Water Act promulgated National Primary Drinking Water Standard Maximum Contaminant Levels (MCLs). MCLs are enforceable standards for contaminants in public drinking water supply systems. They not only consider health factors,

TABLE A.3-1

FEDERAL ARARS AND TBCs(1) CROYDON TCE SITE PHASE II RI/FS

Contaminan	t-Specific
Requirement	Rationale
Hazardous Waste Requirements (RCRA Subtitle C, 40 CFR, Part 264)	Standards applicable to treating, storing, and disposing of hazardous waste.
Safe Drinking Water Act	
Maximum Contaminant Levels (MCLs)	Remedial actions may provide groundwater cleanup to the MCLs.
Maximum Contaminant Level Goals (MCLGs)*	SARA Section 121(D)(2)(A)(II).
Toxic Substances Control Act (15 U.S.C. 2601)	·
TSCA health data, chemical advisories, and Compliance Program policy*	Considered in the public health evaluation.
Health Advisories, EPA Office of Drinking Water*	RI activities identified presence of chemical for which health advisories are listed.
Clean Water Act (PL92-500)	
Federal Ambient Water Quality Criteria (AWQC) - human health through ingestion of water*	Remedial actions may provide groundwater remediation to relevant AWQC.
Reference Doses (RfD), EPA Office of Research and Development*	Considered in the public health evaluation.
Carcinogenic Potency Factors, EPA Environmental Criteria and Assessment Office; EPA Carcinogen Assessment Group*	Considered in the public health evaluation.
Clean Air Act (42 USC 7401)	
National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (40 CFR Part 50)	Remedial alternatives may include incineration or groundwater air-stripping technologies.
Public health basis to list pollutants as hazardous under Section 112 of the Clean Air Act*	Remedial alternatives may include incineration or groundwater air stripping technologies.
***	AR3UU5:

TABLE A.3-1 FEDERAL ARARS AND TBCs(1) CROYDON TCE SITE - PHASE II RI/FS PAGE TWO

Contamina	nt-Specific
Requirement	Rationale
Health Effects Assessments*	Considered in the public health risk assessment included in RI Report.
Pesticides Registration, Tolerances, and Action Levels*	Pesticides are considered possible site contaminants.

Location-Specific		
Requirement	Rationale	
EPA's Groundwater Protection Strategy*	Remedial alternatives must consider EPA classification of groundwater at site.	
Endangered Species Act of 1978 (16 USC 1531)	Considered in the public health and environmental assessment.	
Fish and Wildlife Coordination Act (16 USC 661)	Remedial alternatives may affect protected habitats.	
Fish & Wildlife Improvement Act of 1978 (16 USC 742)	Remedial alternatives may affect protected habitats.	
Fish & Wildlife Conservation Act of 1980 (16 USC 2901)	Remedial alternatives may affect protected habitats.	
Rivers and Harbors Act of 1899 (33 CFR Parts 320-327)	Remedial alternatives may affect the Delaware River.	
Regulation of Activities Affecting Waters of the U.S. (33 CFR, Parts 320-329)	Corps of Engineers regulations apply to navigable waters.	
Section 404(b)(l) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230)	Remedial alternatives may potentially include dredging and filling in wetlands.	
Dredged Material Disposal Sites Removal or Restriction Procedures (404c); 40 CFR, Part 231	Remedial alternatives may potentially include dredging and filling in wetlands.	
Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands)	Both floodplain and wetland resources may be affected by the site remedial alternative.	

TABLE A.3-1 FEDERAL ARARS AND TBCs(1) CROYDON TCE SITE - PHASE II RI/FS PAGE THREE

Action-Specific		
Requirement	Rationale	
Safe Drinking Water Act		
Underground Injection Control Regulations (40 CFR, Parts 144, 145, 146, and 147)	May be applicable to onsite groundwater recirculation systems and tracer studies.	
Clean Water Act		
HPDES Permit Requirements	Remedial alternatives may include discharge to surface waters.	
Threshold Limit Values, American Conference of Governmental Industrial Hygienists*	May be appropriate requirements for air concentrations during remedial activities.	
Occupational Safety and Health Administration Requirements (29 CFR, Parts 1910, 1926, and 1904)	Required for workers engaged in onsite remedial activities.	
Department of Transportation Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1-171.500)	Remedial alternatives include offsite treatment and disposal.	
Hazardous Waste Requirements (RCRA Subtitle C, (40 CFR Part 264)	Applicable to treating, storing, and disposing of hazardous wastes.	
General Pretreatment Regulations for Existing and New Sources of Pollutants (40 CFR Part 403)	Considered for remedial alternatives involving pretreatment of groundwater prior to treatment to a POTW.	

^{1.} ARAR: Applicable or Relevant and Appropriate Requirement.
TBC Other Criterion, Advisory or Guideline "to be considered."

TABLE A.3-2 .

COMMONWEALTH OF PENNSYLVANIA APPLICABLE OR RELEVANT AND APPROPRIATE STATE REQUIREMENTS CROYDON TCE SITE

Action-Specific		
Requirement	Rationale	
Pennsylvania Solid Waste Disposal Regulations, PA Code Title 25, Chapter 75	Standards for treating, storing, and disposing of hazardous wastes.	
Pennsylvania Pollutant Discharge Elimination System (NPDES) Rules, PA Code Title 25, Chapter 92	Remedial actions may include discharge to surface waters.	
Pennsylvania Wastewater Treatment Requirements, PA Code Title 25, Chapter 95	Remedial actions may include discharge to surface waters.	
Pennsylvania Industrial Waste Regulations, PA Code Title 25, Chapter 97	Remedial actions may include discharge to surface waters.	
Pennsylvania Special Water Pollution Regulations, PA Code Title 25, Chapter 101	Applicable for permitted solid waste disposal facilities.	
Pennsylvania Air Pollution Control Regulations, PA Code Title 25, Chapters 121 through 143	Incineration is considered a potential remedial action.	
Pennsylvania Storm Water Management Act of October 4, 1978, Act No. 167	Remedial actions may require stormwater management systems.	
Pennsylvania Erosion Control Regulations, PA Code Title 25, Chapter 102	Soil disturbances during proposed remedial actions may require erosion and sedimentation control measures.	
Pennsylvania Hazardous Substances Transportation Regulations PA Code Title 13 (Flammable Liquids and Flammable Solids) and Title 15 (Oxidizing Materials, Poisons, and Corrosive Liquids)	Applicable to wastes shipped offsite for analysis, treatment, or disposal.	

TABLE A.3-2 COMMONWEALTH OF PENNSYLVANIA APPLICABLE OR RELEVANT AND APPROPRIATE STATE REQUIREMENTS CROYDON TCE SITE PAGE TWO

Contaminan	t-Specific
Requirement	Rationale
Pennsylvania Water Quality Standards, PA Code Title 25, Chapter 93	Remedial actions may include discharge to surface waters.
Pennsylvania Air Pollution Control Regulations, PA Code Title 25, Chapters 121 through 143	Incineration is considered a potential remedial action.

Location	Specific
Requirement	Rationale
Pennsylvania Wild and Scenic Rivers Act	Considered in the public health and environmental assessment. Remedial actions may include discharge to the Hog Run Creek or Delaware River.
Rare and Endangered Species Regulations PA Code Title 58	Considered in the public health and environmental assessment.

TABLE A.3-3

COMPARISON OF PHASE I RI CONTAMINANTS OF CONCERN AND ARARS CROYDON TCE SITE

										AMPC	
Constituent	300	Detected (Fg/1)	Detected (19/1)	4) Mader	PDMR (µ9/1)(1)	Health Advisories (119/1)(1)	ies (µg/1)(1)	(Z)(1/64) wayra i (Z)(w	(2) (1)	Human Health Hydrigh	Health)(2)
	ž	25	£	HCLs/	MCLGs/ PMCLGs	Child	Adult	Acute	Chronic	Ingestion of Drinking Water & Aquetic Life	Ingestion of Drinking Water
trichloroethene	5	7.9	420	(Y)S	(8)0		-	2,000	-	0(2.7)•	0(2.8)*
Let rachloroethene	3	£	1	•	(4)0	10 day: 34,000 longer term: 1,940	longur term: 6,800	5,280	840	0(0.0)	0(0.88)*
1,1,1 trichleroethene	7.5	2.3	160	200(A)	200(B)	206(B) 10 day: 140,000 10 day: 35,000 longer term: 35,000	longer term: 125,880 lifetime: 1,888	18,000		18.4 mg/l	19 mg/l
1,1-dichloroethane	7	ŝ	٠		•			•	•	t	:
1,1-dichloroethene	3:1	Q.H	51	(V)L			•	11,600	-	0(33 ng/1)*	0(33 ng/1)*
chloroform	1.2	G.	6.9	•				28,900	1,240	0(0.19)*	0(0.19)^
1,4-dichlorobenzene	9.20	ę.	£	25	\$1	1 day: 10,700 10 day: 10,700 longer term: 10,700	longer term: 375,000 lifetime: 3,750	250	50	400	470
dieldrin	ē	8	0.3		-			2.5	0.0019	0(0.74 mg/1)*	0(1.2 nq/1)*
4,4'- DOT	ē	Q.	2 .		-			1.1	0.001	0(0.024 ng/1)	0(-1.2 ng/1)

The value corresponds to a 1 x 10-6 lifetime cancer risk

- Sources (1) USEPA, 1986a and 1986b (2) USEPA, 1980 (S)

- Residential Wells
- Monitoring Wells
- Surface Water
- Surface Water
- Hazional Primary Drinking Water Regulations
- Maximum Contaminant Level [µg/l]
- Proposed WCL
- Hazimum Contaminant Level Goel [µg/l]
- Proposed WCL
- Ambient Water Quality Criteria [µg/l]

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but also the economic and technical feasibility of removing a contaminant from a water supply system. EPA has also recently proposed Maximum Contaminant Level Goals (MCLGs) for several organic and inorganic compounds in drinking water. MCLGs are non-enforceable guidelines that do not consider the technical feasibility of contaminant removal.

- Toxic Substances Control Act of 1976 The Toxic Substances Control Act (TSCA) provides authority to require testing of chemical substances entering the environment and to regulate them, where necessary. Polychlorinated biphenyl (PCB) regulation and enforcement (40 CFR Part 761) are important aspects of TSCA. 40 CFR Part 761 established regulations for manufacturing, processing, distributing in commerce, and prohibitions for using PCBs.
- <u>USEPA Health Advisories</u> Health Advisories are non-enforceable guidelines, developed by the EPA Office of Drinking Water, for chemicals that may be intermittently encountered in public water supply systems. Health Advisories are available for short term, longer-term, and lifetime exposures for a 10-kg child and/or a 70-kg adult.
- Clean Water Act (as amended) This act governs pointsource discharge through the National Pollutant Discharge Elimination System (NPDES), as well as discharge of dredge or fill materials and oil and hazardous spills to U.S. waters.
 - Also, Ambient Water Quality Criteria (AWQC) were developed for 64 pollutants in 1980 (45 CFR Part 231) pursuant to Section 304(a)(l) of the Clean Water Act. In 1983, EPA revised nine criteria previously published in the "Red Book" (Quality Criteria for Water, 1976), and in the 1980 criteria documents. These criteria are not legally enforceable, but have been used by many states to develop enforceable water quality standards. AWQC are available for the protection of human health from exposure to contaminants in drinking water, from ingestion of aquatic biota, and for the protection of freshwater and saltwater aquatic life.
- Clean Air Act of 1967 This act governs air emissions resulting from remedial actions. The Clean Air Act promulgated the National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50). NAAQS are available for six chemicals or groups of chemicals and for airborne particulates. The sources of the contaminants and the routes of exposure were considered in the formulation of the standards. These standards do not considered the costs of achievement or the feasibility of implementation. The NAAQS allow for a margin of safety to account for unidentified hazards and effects.

- Health Effects Assessments (HEAs) HEAs present toxicity data for specific chemicals for use in public health assessments. Also considered applicable are Carcinogenic Potency Factors and Reference Doses provided in the Superfund Public Health Evaluation Manual (USEPA, 1986).
- Groundwater Protection Strategy EPA's policy is to protect groundwater as needed for its highest present or potential beneficial use. This policy will be incorporated into future regulatory amendments. The strategy designates three categories of groundwater:
 - Class 1 Special Groundwaters Waters that are highly vulnerable to contamination and are either irreplaceable or ecologically vital sources of drinking water.
 - Class 2 Current and Potential Sources of Drinking Water and Waters Having Other Beneficial Uses - Waters that are currently used or that are potentially available.
 - Class 3 Groundwater Not a Potential Source of Drinking Water and of Limited Beneficial Use - Class 3 groundwater units are further subdivided into two subclasses.
 - -- Subclass 3A includes groundwater units that are highly to intermediately interconnected to adjacent groundwater units of a higher class and/or to surface waters. They may, as a result, be contributing to the degradation of the adjacent waters. They may be managed at a similar level as Class 2 groundwaters depending upon the potential for producing adverse effects on the quality of adjacent waters.
 - -- Subclass 3B is restricted to groundwater units characterized by a low degree of inter-connection to adjacent surface waters or other groundwater units of a higher class within the Classification Review Area. These groundwaters are naturally isolated from sources of drinking waters in such a way that there is little potential for producing adverse effects on quality. They have low resource values outside of mining or waste disposal.
- Endangered Species Act of 1978 (16 USC 1531) This act provides for consideration of the impacts on endangered and threatened species.
- Fish and Wildlife Coordination Act (16 USC 6612 30 05 46 act provides for consideration of the impacts on wetlands and protected habitats.

- Fish and Wildlife Improvement Act of 1978 (16 USC 742a) This act provides for consideration of the impacts on wetlands and protected habitats.
- Fish and Wildlife Conservation Act of 1960 (16 USC 2901) This act, too, provides for consideration of the impacts on wetlands and protected habitats.
- Regulation of Activities Affecting Water of the U.S. (33 CFR Parts 320-329) These U.S. Army Corps of Engineers Regulations are applicable to wetlands and navigable waters.
- Section 404(b)(l), Guideline for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 23) These established guidelines are applicable to the dredge and fill of wetland environments.
- <u>Dredged Material Disposal Sites Denial or Restriction Procedures (Section 404 Procedures) (40 CFR Part 231)</u> These established procedures for prohibiting or withdrawing the specification or denying, restricting, or withdrawing the use for specification, of any defined area as a disposal site for dredged or fill material are pursuant to Section 404(c) of the Clean Water Act.
- Occupational Safety and Health Act (OSHA requirements; 29 CFR Parts 1910, 1926, and 1904) - OSHA regulations provide occupational safety and health requirements applicable to workers engaged in onsite field activities.
- Federal Floodplain Executive Order (11988) This executive order provides for consideration of floodplains during remedial actions. It is implemented by EPA's August 6, 1985 Policy on Floodplains and Wetlands Assessments for CERCLA actions (CERCLA Compliance Policy).
- Federal Wetlands Executive Order (11990) This order provides for consideration of wetlands during remedial actions and is implemented by EPA's August 6, 1985 Policy on Floodplains and Wetlands Assessments for CERCLA actions (CERCLA Compliance Policy).
- DOT Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1 171.500) These regulate the transport of hazardous waste materials including packaging, shipper equipment, and placarding. These requirements are considered applicable to any wastes shipped off site for laboratory analysis, treatments or disposal.

Commonwealth of Pennsylvania ARARs

- <u>Pennsylvania Solid Waste Disposal Regulations</u> These govern the generation, transportation, storage, and disposal of hazardous wastes.
- <u>Pennsylvania National Pollutant Discharge Elimination</u>
 <u>System (NPDES) Rules</u> These rules govern point-source discharge to Pennsylvania waters through the Clean Water Act.
- <u>Pennsylvania Water Quality Standards</u> These set forth water quality standards for receiving streams based upon designated uses.
- Pennsylvania Wastewater Treatment Requirements These wastewater treatment regulations are required to maintain water quality, including effluent limitations based on best-practical-control technologies and waste-level allocations for pollutants for which minimum treatment requirements have not been established.
- Pennsylvania Industrial Waste Treatment Regulations These regulations provide requirements and standards for
 treatment of industrial waste discharges to surface
 waters and underground waters.
- Pennsylvania Special Water Regulations These regulations establish a procedure for mandatory notification of downstream users in the case of an accident in which a toxic substance enters surface waters. They also specify bonding requirements for solid waste facilities that would ensure closure of a permitted site in a manner that would abate or prevent water pollution.
- Pennsylvania Air Pollution Control Regulations These govern air emissions from remedial actions and provide for the control and prevention of air pollutants. They also provide guidance for the design and operation of air pollution sources.
- Pennsylvania Storm Water Management Act This act requires measures to control stormwater runoff during alterations or development of land. Stormwater management systems must be constructed in a manner consistent with the county watershed management plan.
- Pennsylvania Erosion Control Regulations These regulations govern erosion and sedimentation control resulting from remedial actions that may involve earthmoving activities.
- <u>Pennsylvania Hazardous Substances Transportation</u> <u>Regulations</u> - These regulate the transport of flammable

liquids and solids, oxidizing materials, poisons, and corrosive liquids. These requirements may be applicable to any wastes shipped offsite for laboratory analysis, treatment, or disposal.

A.3.4 PRELIMINARY SCOPING OF REMEDIAL TECHNOLOGIES

A focused Feasibility Study (FFS) has been prepared to evaluate alternatives for eliminating public health risks that are present because of consumption of groundwater by domestic well owners. This FFS is primarily aimed at evaluating alternate water supplies and in-house water treatment systems, in addition to the no-action alternative. Remediation of contaminated groundwater (i.e., the entire plume) will be considered in the Phase II FS.

Based on the Phase I RI data, environmental problems associated with the Croydon TCE Site are primarily limited to the groundwater. However, it is possible that during the Phase II RI, the source(s) of the groundwater problem may be identified and subsequently characterized. Therefore, technologies for soil/waste remediation have also been developed and are presented on Table A.3-4.

As shown on Table A.3-4, potential remedial technologies have also been identified for remediating surface water/sediment; however, public health and environmental risks posed by these media are relatively low and consequently, may not require remediation.

The screening of technologies and the identification of innovative technologies will begin shortly after the Phase II RI is initiated. As the RI progresses, additional screening and identification of other technologies will occur. (The screening criteria are discussed in Section A.5.0.) Technologies remaining after screening will be combined into alternatives. To the degree possible, treatment alternatives will be developed that would eliminate the need for long-term management at the site and that would reduce toxicity, mobility, or volume as their principal element, in accordance with SARA.

In the event that the source of the groundwater problem is identified, an amendment to this Work Assignment will be submitted if treatability studies are warranted. This amendment will include a budget increase which will include provisions to research and identify candidate treatability studies, develop treatability study specifications, procure the appropriate vendors to perform the treatability study, and provide management during the treatability study. The results of the treatability study will be used to support the feasibility study and the EPA Record of Decision (ROD).

TABLE A.3-4

POTENTIAL REMEDIAL TECHNOLOGIES CROYDON TCE SITE BUCKS COUNTY, PENNSYLVANIA

		BUCKS COUNTY, FEMNSILVANIA		
Site Media	Proliminary Risks	Potential Remedial Objectives	Response Actions	Potential Remedial Technologies
\$011s	• Leaching to groundwater	• Reduce or eliminate dermal toxicity. • Reduce leaching to groundwater.	Removal Disposal (on/off site) Treatment (on/off site) Containment In-situ treatment	Excavation PCPA Landfill Solidification Incineration Thermal treatment Solvent extraction Slurry wall Cap In-situ solidification/ fixation In-situ vitrification Wapor extraction
Surface water/ sediments	· Blota uptake in offsite ditch and downstream receiving waters	 Reduce or eliminate sediment transport. Reduce contaminant concentrations in offsite sediment. 	Removal Disposal (on/off site) Treatment	Excavation Dredging RCRA Landfill Solidification Incineration Revegetation
Groundwater	· Present and future rishs are not acceptable for ingestion, inhalation, and dermal contact.	 Prevent an increase in conteminant concentrations for receptors. Reduce contaminant concentrations at site. 	Pumping Treatment (onsite) Treatment (offsite) Alternate Water Supply*	Well points Ejector vells Deep vells Brainage trench Air stripping Activated carbon Biological Treatment

*Presently being evaluated as part of the focused feasibility study.

A.3.5 DATA LIMITATIONS/REQUIREMENTS

This section summarizes the data that are necessary to meet the overall objectives for performing the Phase II RI/FS at the Croydon TCE Site. The required data were identified by reviewing the Phase I RI data base and then determining the data needed to adequately meet the Phase I objectives, assess the risks to the public health and environment, and to evaluate the feasibility of remedial alternatives. Table A.3-5 provides the data limitations/ requirements identified during the Phase II RI/FS scoping process. The period of data collection (i.e., Phase I RI or Phase II RI) and the specified end uses of the data (i.e., risk assessment, feasibility study, etc.) are also given in this table. A summary of the specific Phase II RI/FS data limitations/requirements is provided below.

- Potential Source Areas No. 1 and No. 3b were identified during the Phase I RI as areas which may act as potential sources of groundwater contamination. The extent of environmental contamination (soil, groundwater) attributed to these source areas are unknown.
- The limits of the northern boundary of the contaminant plume were not defined during the Phase I RI. Additional data are required to delineate the extent of contamination north of U.S. Route 13.
- Define the position of the groundwater divide near the East branch of Hog Run Creek and its probable impact on the migration of contaminants.
- Determine the nature of the immiscible white liquid found in several of the monitoring wells.
- Define the local groundwater flow patterns near the intermittent stream, which is located north of Potential Source Area No. 1.
- In addition to the groundwater contaminant plume, the Phase I RI results suggest the possibility that another (offsite) TCE plume is migrating to the study area. The boundaries of the Phase I study area need to be expanded to confirm the presence/absence of this plume.
- Confirm the presence/absence of contaminants in the residential wells sampled during the Phase I RI to confidently characterize the risks to the public health.
- The Phase I RI identified the presence of pesticides, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in soil samples obtained from 3 sampling locations. Additional data on the nature and extent of PCB, PAH, and pesticide contamination in background soil samples and in the Rohm & Haas landfill are required. It is currently unknown if the soil

TABLE A.3-5

DATA LIMITATIONS/REQUIREMENTS AND UTILIZATION CROYDON TCE SITE

				Utilization		Data Co Pe	Data Collection Period
Media		Data Limitations/Reguirements	Source Delineation	Risk Assessment	Feasibility Study	Phase I RI	Phase II RI
Hazardous Waste(s)	• • • •	Location Amount (Volume and Mass) Physical Characteristics Chemical Characteristics	ĸĸ	K	***	×	***
Groundwater	•	Areal extent of known contaminant plume	×	×	×	×	×
	•	Groundwater quality throughout entire study area		×	*	×	
	•	Groundwater users		×	×	*	
	•	Groundwater flow patterns and rates		×	×	×	*
-	•	Geologic conditions		×	*	×	* ×
	•	Hydraulic characteristics of the alluvial aquifer		×	*	×	*
	•	Interaction between surface waters and groundwater		×	*	×	*
A	•	Background groundwater quality		×	×	×	××

TABLE A.3-5
DATA LIMITATIONS/REQUIREMENTS AND UTILIZATION
CROYDON TCE SITE
PAGE TWO

				Utilization		Data Co Per	Data Collection Period
Wedla		Data Limitations/Requirements	Source Risk Delineation Assessment	Risk Assessment	Peasibility Phase I Phase II Study RI	Phase I RI	Phase 11 RI
Soils	••	Physical Characteristics Chemical Characteristics	×	×	××	×	x x
Surface Water and Sediments	•	Quality of Weshaminy Creek, Hog Run and intermittent streams		*	X	×	
	•	Impact on Delaware River		×			×
	•	100-Year Floodplain			×		×
Biota	•	Impact on biota in Neshaminy Creek, Hog Run and intermittent streams		×	-	**X	10

Phase I support and confirm t 2 nseq þe also will collection findings/conclusions. Phase II data

sediment samples. A biota investigation will not be conducted during the Phase II RI due to the relatively low levels of contaminants detected in surface waters/sediments. The EPA Region III Bioassessment Division supports this decision. ** Biota studies were considered following the review and evaluation of surface water and

samples represent contaminants detected in the soil, or if these compounds are potentially attributed to the landfill. Fill material from the landfill may have been placed in areas where the Phase I soil samples were collected, based on conversations with a local property owner.

• The quality of surface water and sediment in the Delaware River and the unnamed stream located north of Route 13 was not defined during the Phase I RI. Because of field sampling limitations, no data are available to characterize the nature and extent of contamination associated with these surface water bodies.

A.3.6 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY OBJECTIVES

The overall objectives for the Croydon TCE Site RI/FS are to determine the nature of the public health and environmental risks posed by the site and to identify and establish remedial action alternatives to mitigate these concerns. Because of the limitations associated with the available data, the Croydon TCE Site RI/FS was conducted in two phases. The objectives of the Phase I RI/FS are provided below.

- Characterize the nature and extent of groundwater contamination, which was previously detected in the southeastern portion of the study area.
- Assess the public health and environmental risks posed by groundwater contamination within the study area.
- Determine the quality of local surface waters to estimate the impact from groundwater discharge and estimate health and environmental risks associated with the use of these surface waters.
- Identify potential source areas that may be contributing to groundwater contamination within the southeastern portion of the study area.

Data limitations were identified following a review of the Phase I RI data. The data required to adequately assess the risks to the public health and environment and to evaluate remedial alternatives were then determined. These data limitations were provided in Section A.3.4. To address these limitations, specific Phase II RI/FS objectives were established. The specific Phase II RI/FS objectives and rationale are provided in Table A.3-6.

A.3.7 TECHNICAL RATIONALE, OBJECTIVES, AND METHODOLOGIES FOR DATA COLLECTION

The purpose of this section is to present the methodologies by which the data limitations and the Phase II RI/FS objectives will be addressed. Table A.3-7 outlines the criteria for

TABLE A.3-6

SPECIFIC PHASE II RI/FS OBJECTIVES CROYDON TCE SITE

S	Specific Phase II RI/FS Objectives	Rationale
1.	Investigate Potential Source Area No. 1 and No. 3b to determine whether they are the source of the TCE groundwater contamination.	Data collected during the hydrogeologic and residential well investigations have indicated that the TCE plume may be emanating from the area north of U.S. Route 13. Two potential source areas were identified through the use of historical aerial photographs.
2.	Define the northern boundary of the TCE plume.	Monitoring wells are required both upgradient and downgradient from Potential Source Area No. 1 and No. 3b to define the northern limits of the TCE plume.
3.	Characterize the hydrogeology of the focused area of investigation.	The hydrogeology of the focused area of investigation is well documented with the exception of the area near River Road, which borders the study area to the south. Based on the Phase I RI data, a groundwater divide exists between the East Branch of Hog Run Creek and the Rohm & Haas treatment pond. The role of the groundwater divide is important to assess fate and transport of site contaminants in the groundwater. In addition, there is the possibility that a second TCE plume, emanating east of Rt. 413, may be migrating toward the East Branch Hog Run Creek. This will be assessed during the Phase II RI.

TABLE A.3-6 SPECIFIC PHASE II RI/FS OBJECTIVES CROYDON TCE SITE PAGE TWO

Specific Phase II RI/FS Objectives	Rationale
4. Confirm public health risks posed by the use of groundwater within the study area.	In order to characterize public health risks more accurately, a second round of sampling will be performed on all residential wells within the study area that have exhibited TCE above health-based ARARs.
5. Confirm the presence or absence of PCBs in the soil.	Soil sampling was performed in three areas that allegedly contained fill material from the Rohm & Haas landfill. Analysis of these samples revealed low levels of PCBs and PAHs. A second round of samples will be collected from these areas to confirm the presence/absence of PCBs and PAHs in soil. Soil samples will also be taken from the Rohm & Haas landfill area and two background (offsite) areas.
6. Define the nature and extent of contamination in the Delaware River and the unnamed stream located north of Route 13.	This objective was not fully satisfied during the Phase I RI because the intermittent stream was dry and there were time constraints associated with sampling the Delaware River. To satisfy this Phase I objective, these surface waters will be sampled during the Phase II RI.

TABLE A.3-7

CRITERIA FOR MEETING THE PHASE II RI/FS OBJECTIVES CROYDON TCE SITE

	CACIDON ICE SITE	
RI Objectives	Criteria for Meeting Objectives	Data Collection Activities
Areas No. 1 and No. 3b to determine whether they are contributing to the groundwater contamination at the site.	 Determine the presence or absence of TCE in groundwater upgradient and downgradient from both potential source areas. Assess soil contamination at 	 Install groundwater monitoring wells upgradient and downgradient from Potential Source Areas No. 1 and No. 3b. Collect groundwater samples and analyze the samples for TCL
	these potential source areas.	volatile organics. • Collect soil gas samples at Potential Source Areas No. 1 and No. 3b.
		· Auger soil borings (with sampling) where soil contamination is suspected, based on the results of the soil gas investigation. Analyze soil samples for TCL and TAL constituents.
2) Define the northern boundary of the TCE groundwater plume.	• Determine aquifer characteristics north of U.S. Route 13.	 Install monitoring wells north of U.S. Route 13. Collect groundwater samples and analyze the samples for TCL
A R		volatile organics.

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TABLE A.3-7 CRITERIA FOR MEETING THE PHASE II RI/FS OBJECTIVES CROYDON TCE SITE PAGE TWO

<u></u>	RI Objectives	Criteria for Meeting Objectives	Data Collection Activities
3	Characterize the hydrogeology and extent of groundwater contamination in the focused area of investigation.	• Confirm the presence or absence of TCE contamination in existing REM III/Rohm & Haas monitoring wells, newly installed REM III wells, and in selected Rohm & Haas wells south of River Road. • Confirm aquifer characteristics. • Investigate immiscible liquid detected during the Phase I RI.	• Sample all Phase I and Phase II monitoring wells and selected Rohm & Haas monitoring wells south of River Road. Analyze the samples for TCL volatile organics. • Conduct hydrogeologic testing of all newly installed monitoring wells. Obtain water level measurements from all monitoring wells and staff gauges.
]			• Sample immiscible liquid and analyze for TCL and TAL constituents.
~	Confirm public health risks posed by the use of groundwater within the study area.	 Assess groundwater quality of selected domestic well users. 	 Sample all residential wells within the focused area of investigation that exhibited elevated levels of TCE. Analyze the samples for TCL volatile organics.
	AR30		 Sample selected residential wells outside of the focused area of investigation to confirm Phase I results.

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TABLE A.3-7 CRITERIA FOR MEETING THE PHASE II RI/FS OBJECTIVES CROYDON TCE SITE PAGE THREE

RI Objectives	Criteria for Meeting Objectives	Data Collection Activities
5) Confirm the presence or absence of PCBs, PAHs, and pesticides in soils.	 Resample 3 areas where contaminants were detected. Determine background level of contaminants in soils. 	• Collect soil samples from the 3 previously sampled areas, the Rohm & Haas Landfill, and background area. Analyze the samples for PCBs, PAHs, and pesticides.
	 Determine presence or absence of contaminants in landfill soils 	
6) Define the quality of surface vaters and sediments in the Delaware River and the unnamed stream located north of Route 13 and estimate health risks associated with use of these waters.	 Determine surface water and sediment quality. 	• Collect surface water and sediment samples from the Delaware River and the unnamed stream. Analyze the surface water samples for TCL volatile organics. Analyze the sediment samples for TCL organic

meeting each of the specific Phase II RI/FS objectives and the data gathering activities selected to meet these objectives.

The scoping of the Phase II RI/FS was conducted during a review of the Phase I RI results. This "brainstorming" period resulted in the development of the Phase II RI/FS objectives and the criteria to meet these objectives. Data collection activities were subsequently proposed to satisfy the criteria.

To meet Objective Number 1 (Investigate Potential Source Area No. 1 and No. 3b) a soil investigation will be conducted. The soil investigation includes soil gas analysis, and surface and subsurface soil sampling and analysis. The soil sampling investigation is discussed in detail in Section 4.3.1. The soil sampling investigation will also obtain information to satisfy Objective No. 5 (confirm the presence or absence of PCBs and PAHs in soils).

To satisfy the criteria for characterizing limits of the groundwater plume and the hydrogeology of the focused area, (Objective No. 2 and 3), a hydrogeologic investigation will be conducted. The hydrogeologic investigation is outlined in Section A.4.3.2 of this report. Each aspect of the hydrogeologic investigation (i.e., location and number of wells, sample analysis, etc.) is discussed in Section A.4.3.2. The hydrogeologic investigation will also obtain information to determine the extent to which the potential source areas are contributing to the groundwater contamination.

Objective No. 4 (Assess the Public Health and Environmental Risks Posed by Groundwater Within the Study Area) will be accomplished by obtaining additional data to determine the presence/absence of contaminants (TCE) in domestic wells within the study area. To satisfy this criterion, selected residential wells will be resampled. Section A.4.3.3 (Residential Well Survey/Investigation) discusses the rationale behind the residential well investigation.

To meet Objective No. 6 (Determine the Quality of Surface Waters and Sediments), a surface water and sediment investigation will be conducted. This investigation will consist of collecting surface water and sediment samples from the Delaware River and the unnamed stream located north of Route 13. Section A.4.3.5 outlines the rationale for the various aspects of this investigation.

A more detailed description of the field investigations is given in Section A.4.3 (Field Investigations).

Additionally, to meet the RI/FS objectives, analytical options must be selected. Appropriate analytical options must be chosen to support the Data Quality Objectives (DQOs) for the samples collected. DQOs and Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) goals are discussed to detail in the Field Operations Plan (FOP). The specific

analytical options to support an Phase II RI/FS are given in five general categories.

- Level V Analysis by non-standard methods that may require method modification and/or development, as well as accelerated turnaround time.
 - Level IV All analyses are performed in an offsite laboratory using CLP protocols.
- Level III Laboratory analysis performed in an offsite laboratory using methods other than the CLP Routine Analytical Services (RAS).
 - Level II Field analysis using a mobile laboratory.
 - → Ievel I Field screening or analysis using portable instruments.

A.4.0 TASK PLAN FOR REMEDIAL INVESTIGATION

This mection identifies the tasks that will be implemented to conduct the Phase II RI/FS for the Croydon TCE Site. The RI will be comprised of Tasks 1 through 8 as defined below:

- Task 1 Project Planning
- Task 2 Community Relations
- ◆ Task 3 Field Investigation
- Task 4 Sample Analysis and Data Validation
- Task 5 Data Evaluations
- Task 6 Risk Assessment
- Task 7 Treatability Study/Pilot Testing
- Task 8 Remedial Investigation Report

The FS will be comprised of Tasks 9 through 12 as defined below:

- Task 9 Remedial Alternatives Screening
- Task 10 Remedial Alternatives Evaluation
- Task 11 Feasibility Study Report
- Task 12 Post RI/FS Support

Section A.5.0 provides a detailed description of the FS tasks. The remainder of this section provides a detailed description of the RI tasks.

A.4.1 TASK 1 - PROJECT PLANNING

The performance of this task results in the preparation and submittal of the Draft and Final Phase TI RI/FS Work Plan and Field Operations Plan. The activities that comprise this task are:

- Data Collection and Review
- Site Reconnaissance
 - ARAR/DQO Determination (Preliminary)

• Remedial Alternatives Identification (Preliminary)

• Preliminary Risk Assessment

RI/FS Brainstorming and Scoping Meetings

• Phase II Work Plan Preparation

- Phase II Field Sampling and Analysis Plan (FSAP) Preparation
- Phase II Site Management Plan (SMP) Preparation
- Phase II Health and Safety Plan (HASP) Preparation

A.4.2 TASK 2 - COMMUNITY RELATIONS

All community relations activities for the Phase I and Phase II RI/FS were presented in the Final Phase I RI/FS Work Plan. Therefore, no additional support over and above what is stated in the Phase I RI/FS Work Plan is required.

The REM III Team will or has provided the following support during the Phase I and Phase II RI/FS:

- Preparation of a Draft and Final Community Relations Plan (completed).
- Preparation of 5 fact sheets (2 fact sheets have been prepared to date).
- Participation at 3 public meetings (1 meeting has been conducted to date).
- Preparation of meeting minutes (1 meeting has been conducted to date).

Specifically, a public meeting will be held upon completion of the Phase I RI/FS Report (and Phase II Work Plan), and Phase II RI/FS. Preparation of a Responsiveness Summary will be discussed under Task 12.

A.4.3 TASK 3 - FIELD INVESTIGATIONS

This task describes the various field investigations that will be conducted to collect data for meeting the specific Phase II RI/FS objectives that were discussed previously. The following field investigations will be performed as part of the Phase II RT:

- Hydrogeologic Investigation
- Domestic Well Survey/Investigation
- Surface Water and Sediment Investigation
- Soil Investigation

The following subsections provide the details of these investigations.

A.4.3.1 Field Activities

A.4.3.1.1 Preparation of Bid Specifications and Subcontract Procurement

Under this subtask, two bid specifications will be prepared. subcontractor will be procured for drilling and installation of 15 test approximately wells, and Following the drilling program, a subcontractor will be procured order to remove drums containing drill cuttings preparation decontamination fluids. The of bid specifications was conducted in conjunction with the development of this Phase II Work Plan to avoid delays when procuring subcontractors.

A.4.3.1.2 Mobilization

This subtask will consist of field personnel orientation and of equipment mobilization and will be performed at the initiation of the Phase II field activities, as necessary. A field team orientation meeting will be held at the NUS office to familiarize personnel with the site history, health and safety requirements, and field procedures.

Equipment mobilization may include, but will not be limited to, the setup of the following equipment:

Soil gas survey equipment.

 Sampling equipment for surface water, sediments, and groundwater.

Health and safety decontamination equipment.

The field office trailer was mobilized during Phase I of the RI will be used for the Phase II RI. The trailer is currently located on the Rohm & Haas property and has electrical and telephone service. Before any drilling is conducted, onsite underground utilities will be located by contacting the appropriate utility companies (i.e., gas, electric, telephone).

A.4.3.2 Hydrogeologic Investigation

The goals of the Phase II hydrogeologic investigation at the Croydon TCE Site are to (1) determine if Potential Source Area No. 1 and No. 3b are contributing to groundwater contamination within the study area, (2) define the site geology and hydrogeology north of Route 13, (3) define the possible groundwater divide located in the vicinity of River Road/Rohm & Haas Manufacturing Area B, (4) confirm the extent of the groundwater contaminant plume, and (5) determine whether another TCE plume is migrating into the study area from an offsite source.

Groundwater sampling data from residential and groundwater 3 monitoring wells taken during the Phase I RI have confirmed that groundwater in the southeastern portion of the study area is

contaminated with TCE and other related compounds. These data indicate a possible source of contamination in an area just north of U.S. Route 13 in the area between Penn Street (to the west) and Bristol Lanes (to the east). Historical aerial photographs of this area have been used to identify two potential source areas (No. 1 and No. 3b), which will be the focus of this investigation (see Figure A.4-1).

The specific data outputs from the proposed hydrogeologic investigation will include the determination of the following:

- Extent of contamination in the alluvial aquifer to the north of state Route 13, west of Bristol Lanes and east of Penn Street.
- Groundwater flow patterns and rates in the vicinity of the small intermittent stream north of Potential Source Area No. 1.
- The location of a groundwater divide between the East Branch of Hog Run Creek and the water treatment basins on Rohm & Haas Manufacturing Area B.
- Hydraulic characteristics of the alluvial aquifer at the newly installed, Phase II monitoring wells.
- Confirm the interaction between surface waters and groundwater within the study area.
- · Assess background groundwater quality.

The hydrogeologic field investigation consists of the following:

- Drilling and installation of nine new monitoring wells. A shallow and deep well will be installed at 4 locations and a shallow well will be installed at 1 location. Two locations (MW-16 and MW-17) will be within Potential Source Area No. 1. Three locations (MW-18, MW-19, and MW-20) will be used to assess Potential Source Area No. 3b.
- Sampling and analysis of all newly installed monitoring wells (9), 29 REM III "Phase I" monitoring wells, and 24 Rohm & Haas monitoring wells.
- Hydrologic testing (i.e., slug tests) of newly installed monitoring wells.
- Installation of two staff gauges in the intermittent stream to the north of Bristol Lanes and Potential Source Area No. 1.
- Two comprehensive rounds of water level measurements 0.55m4 all monitoring wells and staff gauges.

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Fig A. 4-1 (See back pocket)

The data obtained through the field investigation will be evaluated and combined with historical site information and available geologic/hydrogeologic publications to provide an assessment of the geologic and hydrogeologic conditions within the site area.

As described above, a total of 9 monitoring wells will be installed. Five well locations have been determined at this time. Four well locations will consist of a water table well and a deep alluvial well. One location (MW19) will consist only of a shallow well. The well locations will provide data to determine lateral and vertical variations in contaminant concentrations, determine vertical flow components within the aquifer, provide data for determining groundwater flow patterns and the area where the source of contamination is located.

The proposed monitoring wells, the REM III "Phase I" monitoring wells, and the location of the Rohm & Haas wells are shown in Figure A.4-1. The rationale for each well location and the primary functions for each well cluster are listed in Table A.4-1. The proposed well locations were selected by the REM III Team with input from EPA based on the locations of suspected source areas, the observed locations of TCE-contaminated wells, the locations of existing groundwater monitoring points currently available for sampling, the overall expected groundwater flow pattern for the area, and the data requirements of the Phase II RI/FS.

Well depths are projected to be approximately 15 to 25 feet deep for water table wells and from 35 to 65 feet deep for deep alluvial wells. Drilling, well construction/installation techniques, well development, and aquifer testing methods are described in the following subsections.

During the field investigation, two staff gauges will be installed in the intermittent stream north of Potential Source Area No. 1. The four staff gauges installed during Phase I of the RI will be re-surveyed for horizontal and vertical control because of suspected vandalism. The staff gauges will provide information to help define local surface water/groundwater interactions.

A.4.3.2.1 Drilling Operations

Hollow stem auger drilling is the preferred method. Potable water may be used if difficult drilling conditions are encountered. Each boring will be lithologically logged by the field geologist via split-barrel samples or cuttings, depending on the drilling/sampling techniques used. A complete log of each boring will be maintained, describing lithologies, depths of contacts, water levels/water yielding zones, total depths, and any other pertinent data that may be discovered in Geologic samples will be described using the Unified Soil Classification System (USCS). For geologic description purposes, split-barrel sampling will be performed at 5-foot intervals during

TABLE A.4-1

PROPOSED MONITORING WELL RATIONALE CROYDON TCE SITE

	Shallow	Well	Function (A = Primary, B = Secondary)	rimary, B = Se	condary)	
NUS Well Location	and Deep Well Cluster	Overall Water Quality	Source Area Identification	Plume Delineation	Groundwater Plov Directions	Rationale
CR-KW16	хөх	8	٧	Ą	el .	Downgradient of potential source No. 1.
Ск-ии17	Yes	æ	«	«	«	Upgradient well cluster from source No. 1. It will be located south of the intermittent stream (If not enough clearance, well may be located on north side of the intermittent stream).
CR-WW18	Yes	s	ď	A	u	Upgradient of potential Source No, 3b.
CR-HW19	ON	4	٧	8	81	Close to suspected source area (Sherwood Refinishing Shop).
CR-MW20	Yes	a	æ	4	B	Downgradient of potential source No. 3b.

operations. Detailed logging procedures for samples are described in the FOP.

Continuous sampling for soil analyses will be performed at monitoring well location MW19 since it is adjacent to a suspected source area. Samples will be collected from the ground surface to the water table, approximately 15 feet. A three-inch split spoon will be used to collect the sample. A total of 5 samples will be taken and analyzed for volatile organics.

A.4.3.2.2 Well Construction/Installation

Monitoring wells will be constructed of NSF-certified 2-inch diameter, nonglued-flush-joint, threaded, Schedule 40 PVC casing and wellscreens equipped with a 2-foot trap below the screen and a PVC end plug. The trap will be used to collect DNAPL if encountered. Figure A.4-2 illustrates typical well construction details for a monitoring well.

Well screens will be 10 feet in length with a slot size of 0.02 inches. The monitoring well installation procedure will consist of placing the PVC pipe and screen into the completed boring and backfilling the annulus of the boring, around the well screen, and approximately 1 to 3 feet above the well screen with clean silica sand. A bentonite pellet seal (minimum 2-foot thickness) will then be installed; the remainder of the annulus of the boring will be backfilled with a cement-bentonite grout to ground surface. The depths of all backfill material will be constantly monitored during the well installation process by means of a weighted steel or plastic tape.

Protective steel casings equipped with locking caps will be installed around all wells. Flush-mounted casings (see Figure A.4-3) may be installed at locations where a protruding casing would be undesirable (near roadways). Keyed-alike locks will be supplied by the drilling subcontractor for all wells. Monitoring wells will be surveyed after installation to determine vertical and horizontal coordinates.

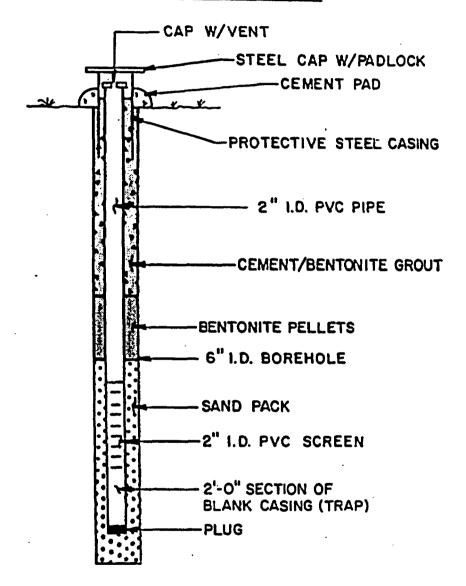
A.4.3.2.3 Well Development

Monitoring wells will be developed after installation to remove fines and sediments from around the well screens and to remove drill cuttings and residual drilling fluids from the area around the monitored interval of the boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist.

A.4.3.2.4 Aquifer Testing

Monitoring wells will be used for aquifer testing to determine of the groundwater flow conditions. The data generated flow these tests will be used to define the water-yielding characteristics of the formation, develop groundwater velocity values for the

MONITORING WELL



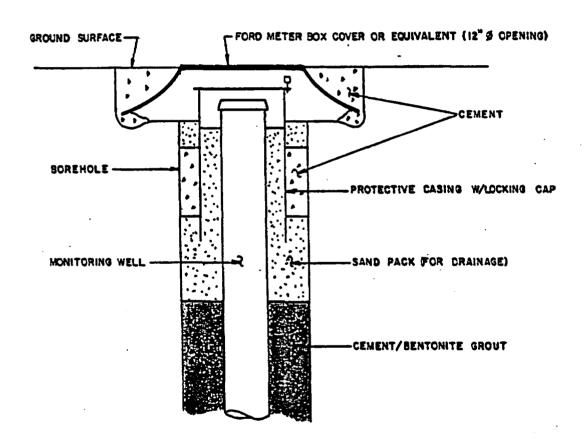
MONITORING WELL CONSTRUCTION DETAILS
CROYDON TCE SITE, BUCKS COUNTY, PA
NOT TO SCALE

FIGURE A.4-2



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FLUSH MOUNTED PROTECTIVE CASING INSTALLATION CROYDON TCE SITE, BUCKS COUNTY, PA

NOT TO SCALE

FIGURE A.4-3



alluvial aquifer, and estimate the rate of groundwater movement across and away from the site. Slug tests will be performed in the newly installed, Phase II monitoring wells and evaluatedusing the most appropriate evaluation technique for each type of test and for each individual set of hydrogeologic conditions. (The wells and evaluation techniques will be determined following the drilling program.) Pressure transducers and data loggers will be used for data collection, where appropriate, to obtain the most accurate field data possible. It is anticipated that each new monitoring well will be tested.

A.4.3.2.5 Water Level Monitoring

At least two comprehensive rounds of water level measurements will be made from the 29 Phase I REM III monitoring wells, the 9 Phase II monitoring wells, and selected Rohm & Haas monitoring wells. Staff gauge readings along Hog Run Creek and the intermittent stream to the north of the site will be recorded during each round of water level measurements. All measurements for each collection round shall be collected within a 24-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater conditions. Measurements will be taken with an M-scope (electrical water-level indicator), that has permanent markings at 1-foot intervals and that has both visual and audio signals. The top of the PVC well casing will be used as the reference point for determining depths of water. These water levels will be used to determine groundwater flow directions and to identify any variations which may occur in flow directions throughout the study area over time.

A.4.3.2.6 Field Sampling Program

Sampling and analysis of groundwater will be performed to define the horizontal and vertical extent of contamination, to delineate the contaminant plume(s), and to provide sufficient data for the assessment of public health and environmental effects, and the evaluation of remedial action alternatives. Sixty-one monitoring wells will be sampled during the Phase II RI. The groundwater sampling program will consist of sampling 9 newly installed monitoring wells, 29 existing REM III Phase I monitoring wells, and 24 Rohm & Haas monitoring wells. One round of groundwater sampling is proposed. Table A.4-2 summarizes the groundwater sampling and analysis program.

Field measurements to be taken on all monitoring wells include:

- pH
- Specific conductance
- Temperature
- Dissolved oxygen

AR300571

These parameters will be measured onsite using calibrated field instrumentation (analytical option Level 1).

TABLE A.4-2

PROPOSED SAMPLING AND ANALYSIS PROGRAM - MONITORING WELLS CROYDON TCE SITE

Media	No. of Samples	Field Duplicates	Pield Blanks	Equipment Rinsate Blanks	· Trip Blanks	Analysis (1) Required	Selected Analytical Option
Monitoring Wells	(1)29	4	4	4	20	TCL Volatile Organics	IV
	3(2)	1	1	1	0	TCL BNA Extractable	IV
	3	1	1	1	0	TCL Pesticides/PCBs	ıv
	3	1	1	1	0	TAL Inorganics (3)	IV
	3	1	1	1	0	roc	111
	62	0	0	0	0	Нq	1
	62	0	0	0	0	Specific Conductance	I
	62	0	0	0	0	Dissolved Oxygen	I
	62	0	0	0	0	Temperature	I

Includes 59 groundwater samples and 3 dense nonaqueous phase liquid (DNAPL)

samples.
DNAPL samples only.
Includes cyanide. 33

Based on the Phase I RI analytical data, volatile organic compounds are considered the principle groundwater contaminants of concern. Consequently, all groundwater samples will be analyzed for Target Compound List (TCL) volatile organic compounds using EPA Method 601/602.

To insure that the data obtained are of sufficient quality for the intended data uses, Data Quality Objectives (DQOs) were established. Analytical options selected to achieve the DQOs include Level IV for the TCL volatile organic analyses.

Level IV was selected to support site characterization, the risk assessment, and the feasibility study.

Additionally, a white immiscible liquid was observed in groundwater during the development and purging of some of the Phase I monitoring wells. This liquid was usually observed after several minutes of pumping. The liquid may be a Dense Nonaqueous Phase Liquid (DNAPL) since it sank to the bottom of the holding container. Since the presence/absence of contaminants associated with this liquid is unknown, it will be sampled during the Phase II RI if observed. A maximum of three samples will be collected and analyzed for the following parameters:

- TCL volatile organics (expanded TIC list)
- TCL base-neutral/acid extractable organics
- TCL pesticides/PCBs
- Target Analyte List (TAL) inorganics
- Cyanide
- Total Organic Carbon
- pH

i.

These data are required to support site characterization, the public health and environmental assessment, and the feasibility study. Level IV analyses was selected to meet the project objectives.

A.4.3.3 Residential Well Investigation

A discussion of the occurrence and distribution of the contaminants detected in the residential wells sampled during the Phase I RI is provided in Section 4.1 of the Phase I RI report. As indicated in Section 4.1, volatile organic contaminants (trichloroethene and related constituents) were detected at levels of potential concern in wells sampled in the vicinity of the TCE plume and/or in other portions of the study area. To confirm the presence/absence of these contaminants and to adequately characterize potential public health risks, selected residential wells will be resampled during the Phase II RI. Residential wells to be resampled include thase 73 located in the vicinity of the contaminant plume.

The residential well sampling and analysis program is summarized in Table A.4-3. A total of 9 residential wells will be sampled and analyzed for TCL volatile organics using EPA Method 601/602. Wells to be sampled for TCL volatile organics include residential wells located in the vicinity of the plume and one residential well located outside of the TCE plume that exhibited trichloroethene at $5~\mu g/l$ (RW 32). Figure A.4-4 depicts the located of these wells.

TAL inorganic constituents and/or nitrate. A total of two residential wells will be resampled and samples submitted for analyses of TAL inorganics. Eight residential wells will be resampled and samples submitted for nitrate analysis as indicated on Table A.4-3.

Analytical options were selected to ensure the data collected are of sufficient quality for the intended data use. To support the Phase II public health assessment, Level IV analytical option was selected.

A.4.3.4 Soil Investigation

The soil investigation for the Croydon TCE Site Phase II RI/FS consists of sampling and analysis of surface and subsurface soils. A discussion of the proposed investigation is provided in the following subsections.

A.4.3.4.1 Surface Soil Investigation

Eight surface soil samples were collected from 3 locations during the Phase I RI. Sampling locations are shown in Figure 4-5 of the Phase I RI Report. These locations included the athletic fields located adjacent to the Mary Devine Elementary School, an area in the vicinity of monitoring well MW-15 (across from Manufacturing Area B), and the yard of a private resident.

Section 4.0 of the Draft Phase I RI report provides a discussion of the occurrence and distribution of constituents detected in the surface soil samples. PCBs (Aroclor 1016 and 1242) were detected in all of the samples at a concentration range of 163 to 590 μ g/kg. Additionally, pesticides and polycyclic aromatic hydrocarbons (PAHs) were identified in several of the samples.

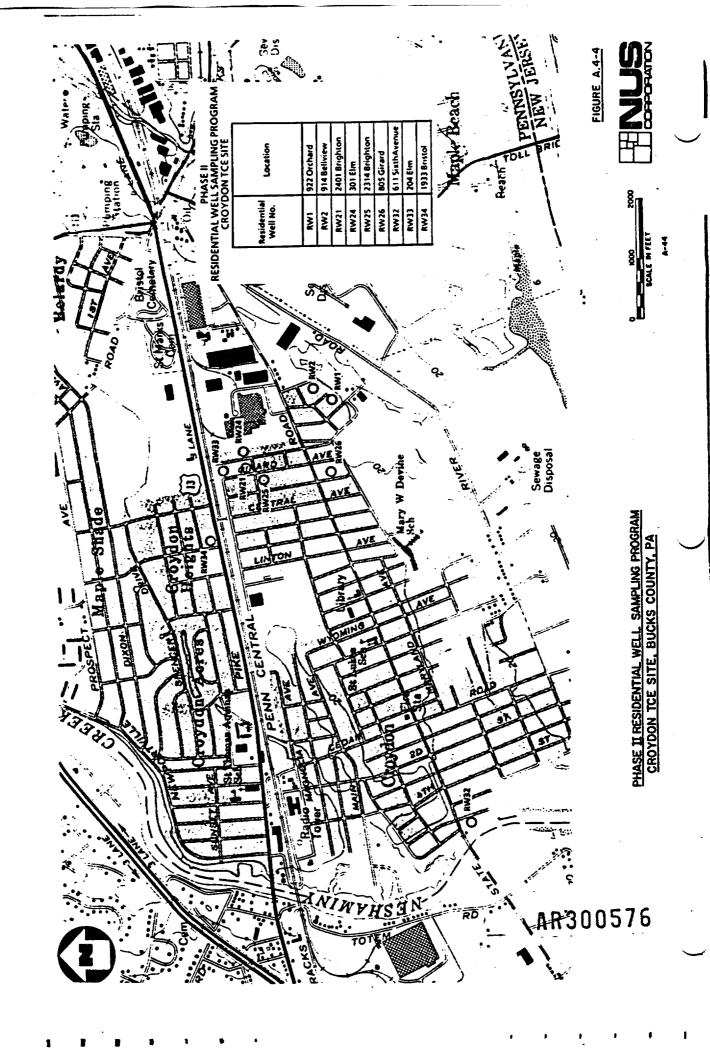
The source of these surface soil contaminants has not been established. It is not likely that they are associated with Potential Source Areas No. 1 and 3b. It is currently unknown whether the levels detected are representative of background concentrations or if a potential source of these contaminants is present within the study area. During the Croydon TCE Site Phase I public meeting, a local resident stated that the Rohm & Haas Landfill is a potential source of these compounds. This resident also indicated that fill material From the landfill was allegedly placed in these areas at some previous time.

TABLE A.4-3

PROPOSED SAMPLING AND ANALYSIS PROGRAM - RESIDENTIAL WELLS

			CRO	CROYDON TCE SITE	TE		
Media	No. of Samples	Field Duplicates	Field Blanks	Equipment Rinsate Blanks	Trip Blanks	Analysis Required	Selected Analytical Option
Residential Wells	6	1	1	0	2	TCL Volatile Organics	IV

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LEGEND

LEGEND

DENOTES SURFACE SOR SAMPLE LOCATION
NUMBER 9

FIGURE A4-5

FIGURE A4-5

HASE II SURFACE AND SHALLOW SOIL SAMPLING L

A surface soil sampling and analysis program will be conducted during the Phase II RI to confirm the presence/or absence of these compounds, to establish background concentrations, and to evaluate the Rohm & Haas landfill as a potential contaminant source. Table A.4-4 summarizes the scope of the surface soil sampling and analysis program. Figure A.4-5 illustrates the Phase II RI soil sampling locations.

Two surface soil samples will be collected from each of the previously sampled locations (i.e. athletic fields, area in the vicinity of MW-15, and in the yard of the private resident) to confirm the presence/absence of contamination.

To establish background concentrations, two background samples will be collected. Exact sample locations will be determined in the field to ensure that the samples are obtained outside of the study area.

To determine whether the landfill is a potential contaminant source, surface (0"-6") and shallow (36"-48") soil samples (grab) will be collected from the Rohm & Haas landfill area. Two surface soil samples and two shallow soil samples will be obtained for analysis. The shallow soil samples will be collected at a depth of 3 to 4 feet using a hand auger.

All samples collected will be submitted for analysis for the following parameters:

- TCL Base/Neutral/Acid extractable organics.
- TCL Pesticides/PCBs.

These data are required to support the public health and environmental assessment. To support the DQOs, Level IV analytical option was selected.

Shallow soil samples will also be collected near the Sherwood Refinishing Shop, which is suspected as the source within Potential Source Area No. 3b. Four shallow borings will be hand augered to a depth of 4 feet. Two soil samples will be collected from each shallow boring; a surface sample (0-6 inches) and a shallow soil sample (3-4 feet). The locations will be based on the results of soil gas analysis or visual observations. Table A.4-4 outlines the required analyses.

A.4.3.4.2 Subsurface Soil Sampling

Adequate source characterization is essential to the Superfund RI/FS process. At sites where soils are considered a source of contaminants, the chemical nature and concentrations of the contaminants and the locations and volumes of contaminated soils must be determined. As discussed in Sections 1.0 and 2.400 (18578) RI Report, Potential Source Area No. 1 and No. 30 were implicated as potential sources of groundwater contamination. All monitoring and residential wells located downgradient of

TABLE A.4-4

PROPOSED SAMPLING AND ANALYSIS PROGRAM - SURFACE AND SHALLOW SOILS CROYDON TCE SITE

Media	No. of Samples	Field Duplicates	Field Blanks	Equipment Rinsate Blanks	Trip Blanks	Analysis Required	Selected Analytical Option
Surface and Shallow Soils at suspected landfill dumping areas.	14	1	1	1	0	TCL BNA Extractables	IV
	14	1	1	1	0	TCL Pesticides/PCBs	IV
Surface and shallow soils near Sherwood Refinishing Shop.	©	. 1	1	τ	1	TCC Volatile Organics	ΝI
	4	0	0	0	0	BTU, Percent Ash, TOC	ΙΛ

these source areas were contaminated with TCE and related compounds. No residential wells upgradient of these source areas exhibited TCL organic contamination. The soils investigation for the Croydon TCE Site Phase II RI/FS is designed to provide the necessary data with which to characterize these potential source areas and to support the feasibility study.

The general technical approach to the source characterization includes a preliminary soil gas testing investigation to identify areas consequently warranting further study at the two potential source areas, and a refined soil gas testing program to delineate the extent of the contamination. If contaminant "hot spots" are identified by the soil gas investigation, a confirmatory soil boring sampling and analysis program will be conducted.

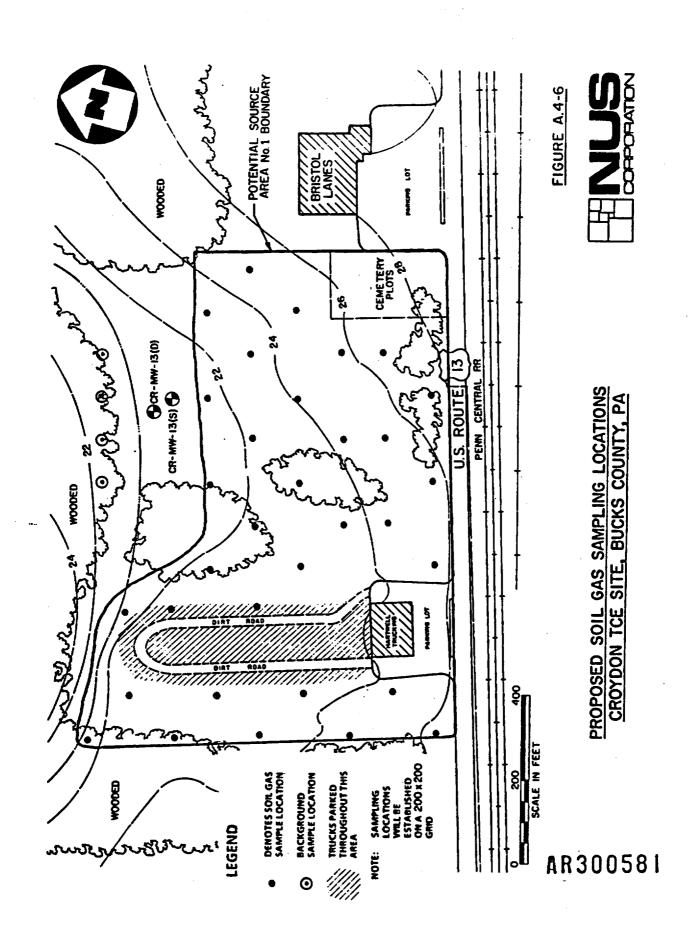
Soil gas testing will be conducted over the entire potential source area No. 1. However, only a small portion of potential source area No. 3b will be investigated via soil gas. This area is the property of the Sherwood Refinishing Shop, which is located just east of Penn Street along U. S. Route 13.

Soil Gas Sampling

The soil gas method includes drilling (hand augering) shallow 3-inch boreholes to a desired depth (2-4 feet). A soil gas sampling probe, consisting of a 3-foot section of PVC pipe with a fixed expansion bulb to seal the annular space, is inserted into the borehole. The probe is fitted with a cap including a reducing fitting that allows the probe to be connected to a pump with flexible tubing. The pump is operated long enough to purge approximately 10 probe volumes and a sample is obtained directly from the flexible tubing with a syringe. The sample may then be injected directly into a photovac portable gas chromatograph with a photoionization detector. Numerous other methods of soil gas sampling and analysis exist. However, the low detection limits afforded by the photovac, as well as the simplicity of this method make this approach favorable. The soil gas samples will be analyzed for PCE, TCE, and TCA (Analytical Option II).

For Potential Source Area No. 1, a preliminary survey will be based on an unbiased 200-foot grid (see Figure A.4-6). A 200-foot grid was selected to provide adequate coverage of this suspected source area. For potential source area No. 3b, a much smaller grid (10 foot) will be used to assess the extent of soil contamination. The area of concern within potential source area No. 3b is estimated to be 25 feet by 60 feet in total area. As mentioned previously, the area of concern is the Sherwood Refinishing Shop.

The data from the preliminary survey will be reviewed in the field with EPA, and isoconcentration plots will be generated. Contaminated areas should be identifiable based to the isoconcentration plots. A refined soil gas survey grid will



then be generated and sampling will be conducted to further define the contaminated area(s). As shown on Figure A.4-6, preliminary soil gas survey points have been identified. The number of grid points included in the refined survey cannot be determined at this time. Additionally, background soil gas samples will be obtained to determine background levels.

Subsurface Soil Sampling

Areas exhibiting the highest degree of soil gas contamination will be evaluated further via a subsurface soil sampling and analysis program. Areas exhibiting the highest degree of contamination will be identifiable by evaluating isoconcentration plots of the soil gas data. A single soil boring will be installed at each "hot spot" identified on the isoconcentration map. (A "hot spot" is defined as a sampling node which exhibits the presence of PCE, TCE, or TCA.) Continuous split-spoon soil samples will be collected from the initial boring to the water table (approximately 15 feet). A 3-inch split spoon will be used to ensure a sufficient quantity of sample is obtained for analyses.

If soil contamination is evident in the samples, based on air monitoring (HNU), headspace analysis, or visual analysis, an additional four soil borings will be installed at each corner of the contaminated area(s). These four soil borings will assist in determining the horizontal and vertical extent of soil contamination. Split-spoon soil samples will be collected in each of the four borings as previously described. If no contamination is evident in the initial boring, then the additional four soil borings will not be required.

Each sample collected will be submitted to a laboratory for analysis. The following analyses will be conducted:

- TCL volatile organics
- TCL base-neutral/acid extractable organics
- TCL pesticides/PCBs
- TAL inorganics

Level IV analysis is required for the TCL and TAL analyses since these data will support the risk assessment and feasibility study.

Additionally, a maximum of four soil samples from each contaminated area will be analyzed for the following parameters:

- pH
- BTU content
- Percent ash
- Grain size distribution
- Moisture content
- Nitrogen
- Phosphorous
- ጥርር

- COD
- BOD

The actual boring location and sampling depth will be determined in the field, based on areas exhibiting the highest soil gas readings or by visual inspection of drill cuttings.

These data are required to evaluate potential remedial technologies (i.e., incineration, fixation, in-situ treatment) for the feasibility study. The analytical option selected to meet this objective is Level III.

Table A.4-5 summarizes the scope of the soil sampling and analysis program. It is not possible to estimate the actual number of soil borings and soil samples that will be collected at this time. The number of borings installed and the number of samples obtained will depend upon the results of the soil gas survey and the presence/absence of contamination identified in the initial boring. However, it is assumed that a total of 15 borings and 45 soil samples (3 samples from each boring) will be submitted for analysis.

A.4.3.5 Surface Water and Sediment Investigation

Surface water and sediment samples were collected during the Phase I RI to determine the quality of local surface waters within the study area. The data were used during the Phase I RI to estimate health risks associated with the use of these waters. Because of field constraints or limitations during the Phase I field investigation, surface water and sediment samples were not collected from the unnamed tributary located north of Potential Source Area No. 1 or from the Delaware River. To characterize surface waters and sediments within the study area, samples from these surface water bodies will be obtained during the Phase II RI.

The proposed Phase II surface water and sediment sampling locations are presented on Figure A.4-7. Table A.4-6 summarizes the rationale for each sampling location. Sample analyses are provided in Table A.4-7.

All surface water samples will be analyzed for the following:

- TCL volatile organics (EPA Method 601/602)
- Hq •
- Specific conductance
- Alkalinity
- Dissolved oxygen
- Total suspended solids

Additionally, the sediment samples obtained from the same location will be analyzed for the following parameter 4.30583

- TCL volatile organics (EPA Method 601/602)
- TCL base-neutral/acid extractable organics

TABLE A.4-5

PROPOSED SAMPLING AND ANALYSIS PROGRAM - SUBSURFACE SOIL SAMPLES CROYDON TCE SITE

Media	No. of Samples	Field Duplicates	Bottle Blanks	Equipment Rinsate Blanks	Trip Blanks	Analysis (1) Required	Selected Analytical Option
Subsurface Soils	45(1)	3	3	3	10	TCL Volatile Organics	IV
	45	3	3	3	0	TCL BNA Extractable	IV
	45	3	3	3	0	TCL Pesticides/PCBs	ΙV
	45	3	3	3	0	TAL Inorganics (2)	IV
	12(3)	1	0	0	0	BTU, Percent Ash, Grain Size, CEC, Moisture Content, Nitrogen, Phosphorus, TOC, COD, BOD, pH	111

325

Assumes 3 samples from 15 borings. Includes cyanide Assumes 4 samples from 3 potentially contaminated areas.



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Station No. •	Description Delaware River - Upstream Delaware River - Adjacent to Rohm and Haas landfill area
6 0	Delaware River - Downstream from confluence with Hog Run Creek
81 81	Intermittent stream near Potential Source Area No. 1 (eastern portion)
61	Intermittent stream near Potential Source Area No. 1 (central portion)
92	Intermittent stream near Potential Source Area No 1 (western portion)
21	Hog Run Creek prior to discharge into the Delaware River

Station Numbers were not sampled during the Phase I RI due to unanticipated field conditions

Denotes Surface Water and Sediment Sampling Location Number 19 **@**

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ROCKDALL (413) BELARDY Se a se WEST BRISTOL ુ ... • Q PENN CENTRAL PRINTEDO **Æ** CROYDON HEIGHTS MAPLE SHADE See to CROYDON ACRES 4 A1VEA CROYDON DE! GWARE AR300585

PHASE II SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS CROYDON TCE SITE, BUCKS COUNTY, PA

TABLE A.4-6

SURFACE WATER/SEDIMENT SAMPLING LOCATIONS AND RATIONALE CROYDON TCE SITE

Station No.*	Description	Rationale
6	Delaware River - Upstream	Determine background surface water/sediment quality.
7	Delaware River - Adjacent to Rohm & Haas landfill area	Determine surface water/ sediment quality prior to potential influence of Hog Run Creek.
8	Delaware River - downstream from confluence with Hog Run Creek	Assess impact from Hog Run Creek
18	Intermittent stream near Potential Source Area No. 1 (eastern portion)	Assess impact, if any, of groundwater. Determine influence of Potential Source Area No. 1.
19	Intermittent stream near Potential Source Area No. 1 (central portion)	Same as No. 18.
20	Intermittent stream near Potential Source Area No. 1 (western portion)	Determine impact, if any, of groundwater in this portion of the study area.
21	Hog Run Creek prior to discharge into the Delaware River.	Evaluate impact on Hog Run Creek from the Rohm & Haas Landfill.

^{*}Station numbers can be cross-referenced with Figure A.4-7.

TABLE A.4-7

PROPOSED PHASE II SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS PROGRAM CROYDON TCE SITE

Media	No. of Samples	Field Duplicates	Field Blanks	Equipment Rinsate Blanks	Trip Blanks	Analysis Required	Selected Analytical Option
Surface Water	9	1	τ	1	1	TCL Volatile Organics	IV
	9	1	, 0	0	0	TSS	I
	9	1	0	0	0	Alkalinity	I
	و	1	0	. 0	0	Specific Conductance Temperature, DO, pH	H
Sediment	9	1	1	1	1	TCL Organics	IV
	9	1	1	1	0	TAL Inorganics*	IV
	9	0	0	0	0	pH, temperature, specific conductance	Ι
	9	0	0	· 0	0	TOC, grain size, percent moisture	111

* Includes cyanide.

- TCL pesticides/PCBs
- TAL inorganics
- Cyanide
- pH, Specific conductance, TOC, grain size, percent moisture

These data are required to characterize surface water and sediments for the public health and environmental assessment and for the feasibility study. Consequently, analytical options selected include Level IV analyses for the TCL and TAL parameters and Level I for the pH analyses.

A.4.4 TASK 4 - SAMPLE ANALYSIS AND VALIDATION

A.4.4.1 <u>Sample Analysis</u>

Tables A.4-2 through A.4-7 summarize the sample analysis for each sample by media for the Phase II RI field activities. The number of samples to be collected, including QA/QC samples, is also provided in these tables. All samples will be analyzed by laboratories that participate in the EPA Contract Laboratory Program. If CLP laboratory analysis cannot be arranged, the samples can be analyzed by the REM III Laboratory Program. REM III laboratories will be employed to analyze a limited number of soil analyses including BTU content, percent ash, grain size, pH, BOD, COD, TOC, and percent moisture.

A.4.4.2 Quality Control and Data Validation

Validation is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use. The process includes the following activities:

- Auditing calibration measurement system and calibration verification.
- Auditing quality control activities.
- Screening data sets for outliers.
- Reviewing data for technical credibility versus the sample site setting.
- Auditing field-sample, data records and chain-of-custody.
- Checking intermediate calculations.
- Certifying the previous process.

The review and validation of CLP or REM III laboratory data will be conducted by REM III Team chemists using the following EPA documents:

- USEPA, 1987. Laboratory Data Validation, Functional Guidelines for Evaluating Organic Analyses with modifications for use within Region III. EPA Technical Directive Document No. HQ8410-01. Hazardous Site Control Division. USEPA OSWER, Washington, D.C. September 9, 1987.
- USEPA, <u>Laboratory Data Validation</u>, <u>Functional Guidelines</u>
 <u>for Evaluating Inorganic Analyses</u>. EPA Office of
 <u>Emergency and Remedial Response</u>. USEPA OSWER,
 Washington, D.C.

Several factors that will be considered during validation are sample holding times, instrument calibration, blank results, surrogate recoveries, matrix spike/matrix spike duplicates, chain-of-custody, and any other control procedures that are applicable.

A.4.5 TASK 5 - DATA EVALUATION

The purpose of this task is to organize the validated data collected from the field and laboratories into a working format for analysis and then perform the necessary evaluations to meet the project objectives. Task 5, therefore, has two distinct components, data reduction and data evaluation. Following are brief descriptions of these components.

A.4.5.1 Data Reduction

Data obtained from the various field investigations will be condensed and organized to facilitate evaluation and presentation in this subtask. Both the Phase I and Phase II data will be considered in the Phase II RI/FS. Reduction of hydrogeologic data will result in the production of various tables, figures, and drawings describing and summarizing the pertinent site features. These might include

- Figures displaying boring and monitoring well locations and elevations.
- Various hydrogeologic cross-sections.
- Flow nets and groundwater contours.
- Well log descriptions.
- Aguifer test data.

Data reduction will be facilitated by computerization. The computerized sampling and analytical data base will be amenable to manipulation and creation of different sorting profiles. Sorting profiles will assist in evaluating the occurrence rand distribution of contaminants within the different media. Appropriate tables, maps, and figures will be produced to

summarize the occurrence and distribution of contaminants at the site and adjacent environs.

A.4.5.2 <u>Data Evaluation</u>

Once the data are reduced to a usable format, the data will be reviewed and evaluated to determine whether the Phase II RI/FS project objectives have been met. Following a preliminary assessment of the field investigation findings, a meeting will be held between USEPA Region III and the REM III Team to evaluate the Phase II results.

A.4.6 RISK ASSESSMENT

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A.4.6.1 Baseline Public Health/Environmental Assessment

The public health/environmental assessment will address the potential human health and environmental effects associated with the Croydon TCE Site under the no-action alternative. The no-action alternative assumes that no remedial (corrective) actions will take place at the site. Evaluation of the no-action alternative is required under Section 300.68(f)(v) of the National Contingency Plan (NCP). By conducting such an assessment, the Environmental Protection Agency (EPA) will be able to determine if remedial actions are indicated for any area of the site. In addition, the baseline assessment will also provide a basis for determining the reduction in risk resulting from remediation. The baseline assessment will be based on the RI environmental monitoring data and other information developed during the RI. The main steps in this assessment will be performed in accordance with the latest EPA policy and guidance on risk assessment in general and for Superfund sites in particular (EPA, 1986d).

The first step in the public health/environmental assessment will be to review the results of the environmental sampling and other information developed during the Phase I and Phase II RIs to identify chemicals of potential concern for detailed study during the risk assessment. A key element in this screening process is a comparison of site concentrations to background levels of chemicals in appropriate media; naturally occurring chemicals present at background concentrations will not be considered to be site-related and will not be evaluated in the assessment. In addition, chemicals present in blanks at similar concentrations (i.e., laboratory and field contaminants) will not be selected for the detailed analysis. Depending on the number of chemicals detected at the site, selection of a subset of chemicals referred to as the chemicals of concern or indicator chemicals may not be necessary. If the selection is needed, relative concentration, mobility, persistence, and toxicity of the contaminants in the environmental samples taken at the site will be considered. AR300590

The objective of the exposure assessment is to identify actual or potential routes of exposure and characterize the likely

magnitude of exposure to human or environmental receptors. Potential human exposure pathways that may be important under current or future land-use conditions include ingestion of groundwater, inhalation of volatiles released from groundwater, exposure to environmental receptors from the surface water bodies at the site, as well as any other potentially complete For each exposure scenario, concentrations relevant environmental media (air, surface water, groundwater, soil) at the potential receptors' locations will Where concentrations have not been measured at the identified. exposure point, estimates of current concentrations may, in certain instances, be made using models. The choice of models will be based on the sampling results. They may be simple partitioning models to determine release from soil or water to another medium (e.g., air) or more complex transport models. It is not possible to identify the specific models that will be selected here since it is not known what the data will reveal about the distribution of chemicals from the site. Should the modeling become necessary, the appropriate models will be selected from the available literature (i.e., EPA publications and reviewed journals). As part of this scope of work, models to predict the release of volatiles from groundwater used in the home will be developed as discussed below. All models and assumptions will be documented in the report and supplemented with appendices as appropriate.

Chemical intakes for each human exposure scenario will be estimated based on frequency and duration of exposure and rate of media intake (e.g., amount of water ingested per day). Human exposure is expressed in terms of intake which is the amount of a substance taken into the body per unit body weight per unit time. A chronic daily intake (CDI) is averaged over a lifetime for carcinogens (EPA, 1986a) and over the exposure period for noncarcinogens (EPA, 1986b). The CDI is calculated separately for each exposure pathway, since different populations at risk may be affected by the individual pathways. The assumptions used in these estimates will be stated clearly and will be thoroughly documented to the extent possible. The assumptions will be selected to represent an "average exposure case" and a "plausible maximum case." The exposure of nonhuman receptors will be estimated based on the sampling results or, if necessary, on the use of appropriate models that have appeared in the open literature.

Included in the risk assessment task will be the development of models which may quantify exposure by a variety of indoor air pathways. The pathways that will be considered are inhalation while showering, washing clothes, flushing the toilet, washing dishes, and any other indoor activities which require the use of water and could result in the release of volatile organics. The number of models that will be developed will depend on the amount of information that can be used to quantify releases of All assumptions will be documented and presented in the report?

The quantitative risk assessment will combine the results of the exposure assessment with the critical toxicity values in the appropriate media for each chemical of concern. For humans, toxicity data will be presented as

- 1. The carcinogenic potency factor for potential carcinogens.
- 2. The estimated risk reference dose (RfD) for noncarcinogens.
- 3. A semi-quantitative characterization based on any pertinent information that is available (e.g., subchronic toxicity studies or structural analogies) for chemicals for which no critical toxicity values are available.

For environmental receptors, environmental concentrations that have been associated with adverse effects in field or laboratory studies will be identified when available.

In addition to critical toxicity values, any applicable or relevant and appropriate requirements (ARARs) that have been established for the potential chemical(s) of concern will be identified. Currently, EPA considers maximum contaminant levels (MCLs) developed under the Safe Drinking Water Act, Federal Ambient Water Quality Criteria (AWQC), National Ambient Air Quality Standards (NAAQS), and state environmental standards to be potential ARARs for use in risk assessment at Superfund sites.

Risk assessments will be conducted separately for each exposure pathway and for each source, when appropriate. Results will be presented separately for the "average exposure case" and the "plausible maximum case" exposure assumptions. The risk assessment for each exposure pathway will include a discussion of the uncertainties in the estimates.

A.4.7 TASK 7 - TREATABILITY STUDY/PILOT TESTING

Treatability studies on soils (and not groundwater) may be conducted as part of the Phase II RI/FS if the source of the TCE groundwater contamination can be identified during the Subsurface Soil Investigation. If the source is identified and subsequently characterized, the REM III Team will perform the following:

- Conduct preliminary screening of technologies based on compatibility evaluation using field data obtained during the Phase II RI.
- Conduct a literature study to determine pertinent remediation technologies and tests needed for evaluation 4R300592
- Prepare and submit a treatability study evaluation report to EPA for review.

- Develop specifications for performing bench-scale treatability studies and issue inquiries to qualified vendors.
- Procure vendor(s) to implement the treatability study.
- Manage and oversee the implementation of the bench-scale treatability studies.

The results of the treatability study will be available during the feasibility study and will be used to support the evaluation of alternatives for soil (source) remediation. Subcontracting dollars have been included in the Phase II RI/FS budget.

A.4.8 TASK 8 - REMEDIAL INVESTIGATION REPORT

This task encompasses the preparation of the draft and final editions of the Phase II Remedial Investigation Report. The Phase II RI Report will contain both the Phase I and Phase II RI results and will include the following discussions:

- Site features investigation
- Hydrogeologic investigation
- Residential well survey and investigation
- Surface water and sediment investigation
- Soil investigation
- Public health and environmental concerns

A meeting will be held at EPA Region III following the development of the Draft Phase II RI Report. This meeting will summarize the findings of the Phase II RI.

A.5.0 TASK PLAN FOR FEASIBILITY STUDY

A Feasibility Study (FS) (Phase II) will be conducted following the Phase II RI. The Phase II FS will evaluate alternatives to address groundwater contamination in the southeastern portion of the study area and alternatives that mitigate contaminant sources (if identified during the Phase II RI). The Phase I FS, a focused feasibility study, is being undertaken at this time to assess the problem of residents depending on groundwater as a potable water supply source. The Phase II FS will consist of four tasks:

- Task 9 Remedial Alternatives Screening
- Task 10 Remedial Alternatives Evaluation
- Task ll Feasibility Study Report
- Task 12 Post-RI/FS Support

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The overall objective of the Croydon TCE Site FS is to screen and evaluate remedial alternatives to mitigate public health and environmental concerns as discussed in the risk assessments 30 to 30 to

information gathered and evaluated under this task will be sufficient to allow EPA to select a remedial action that is

- · Protective of human health and the environment
- Cost-effective
- In accordance with CERCLA as amended by SARA
- In accordance, to the extent possible, with the NCP (Section 300.68)

A.5.1 TASK 9 - REMEDIAL ALTERNATIVES SCREENING AND DEVELOPMENT

The objective of this task is to refine the range of response actions developed during the scoping process (Task 1). The alternatives will be screened using a definite set of criteria. Only those alternatives which pass the initial screening process will undergo full evaluation.

This task will employ data collected in the Field Investigation (Task 3), Data Evaluation (Task 5), and Risk Assessment (Task 6). The subtasks comprising Task 9 will accomplish the following objectives:

- Development of remedial response objectives and General Response Actions.
- Identification and screening of applicable technologies.
- Assembly and preliminary screening of remedial alternatives.

A.5.1.1 <u>Development of Remedial Response</u> <u>Objectives and Response Actions</u>

Based on the data collected in the Phase I and II RIs, the remedial response objectives will be developed more fully. Specific response objectives will be developed using a risk-based methodology to define cleanup levels that would reduce risks to public health and the environment to acceptable levels (this includes ARAR considerations and risk levels as presented in <u>Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites</u> (USEPA, 1986a). Potential contaminant migration routes and exposure pathways, identified in the Risk Assessment, will be examined further as a basis for estimating acceptable contamination levels. Acceptable exposure levels for potential receptors will be identified and cleanup levels will then be estimated. Development of response objectives will also include refinement of ARARS specific to the site.

A.5.1.2 <u>Identification of Applicable Technologies</u> and Assembly of Alternatives

Based on the remedial response objectives, a list of applications technologies will be identified. The technologies list will contain those previously identified in Section A.3.0. After

potential remedial technologies have been selected, operable units will be defined for each site condition requiring remediation (i.e., soils and groundwater). Each operable unit should meet at least one response objective.

After operable units have been defined, remedial alternatives will be identified. Each remedial alternative will be an overall site remedy incorporating more than one operable unit. The no-action alternative will be considered a baseline against which the other alternatives can be evaluated.

CERCLA, as amended by SARA, states that, to the maximum extent practicable, remedial actions that utilize permanent solutions and alternative treatment technologies or resource recovery technologies must be selected. Therefore, remedial actions that use these technologies will specifically be considered. To the extent possible, treatment options will range from alternatives that eliminate the need for long-term management at the site to alternatives involving treatments that would reduce toxicity, mobility, and volume as a principal goal.

A.5.1.3 Screening of Remedial Technologies/Alternatives

The lists of technologies and alternatives developed will be screened. The objective of this effort is to eliminate from further consideration any technologies and alternatives that are undesirable regarding implementability, effectiveness, and cost. The list of alternatives being considered will be narrowed by eliminating the following types of technologies:

- Technologies/alternatives that are not implementable or technically inapplicable.
- Technologies/alternatives that are not effective because they have adverse environmental impacts, do not provide adequate protection of public health, or do not attain ARARS.
- Technologies/alternatives that are more costly than other alternatives/technologies but do not provide greater environmental or public health benefits, reliability, or a more permanent solution. : Costs will not be used to discriminate between treatment technologies and nontreatment technologies.

Reasons for elimination of any alternative at this stage will be documented in the FS report.

A meeting with EPA will be held following the screening of remedial technologies/alternatives to obtain EPA's concurrence on the list of alternatives that will undergo detailed evaluation.

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A.5.2 TASK 10 - REMEDIAL ALTERNATIVES EVALUATION

Remedial alternatives that pass the initial screening process (Task 9) and the no-action alternative will be further evaluated in detail and compared, as required in the NCP and in CERCLA, as amended by SARA. Effectiveness, implementability, and cost will be considered. The effectiveness evaluation will include consideration of public health, environmental impacts, and attainment of ARARs. As part of this evaluation process, SARA Subsection 121(b)(1) requires that waste, site, and inherent limitations, as well as the ability of each alternative to meet ARARs, be taken into account. Factors that would receive special consideration include:

- The long-term uncertainties of land disposal.
- The goals and requirements of the Solid Waste Disposal Act.
- The persistence, toxicity, mobility, and bioaccumulation of contaminants at the site.
- The short- and long-term potential for adverse human health effects.
- The long-term maintenance costs.
- The potential for future remedial action costs if the remedy fails.
- The potential threat to human health and the environment from the excavation, transportation, and redisposal or containment of hazardous substances, pollutants, or contaminants.

Both short- and long-term effects for each of these factors will be assessed. To the extent possible, remedial alternatives that use permanent solutions and alternative treatment technologies will be considered.

A.5.2.1 <u>Implementability Evaluation</u>

Each alternative will be evaluated for technical feasibility, administrative feasibility, and availability of the technology. Performance will be evaluated in terms of efficiency and useful life. Feasibility will be evaluated based on operation and maintenance requirements, and on the demonstrated performance of the remedial technologies involved. However, innovative treatment technologies or technologies achieving permanent solutions will not be eliminated because they have not been proven. During the analysis of technical feasibility, conditions on the site and external to the site will be considered. An estimate of the time required to implement the alternative, as well as the time required to achieve beneficial results, will be analyzed. Safety evaluations will include both

the short-term and long-term threats to the safety of nearby communities and environments and of workers onsite. To the extent possible, special consideration will be given to technologies that provide treatment, resource recovery, or permanent solutions. The long-term uncertainties will be carefully considered.

A.5.2.2 Effectiveness Evaluation

A baseline risk assessment will be conducted for the Phase II RI as part of Task 6 - Risk Assessment. This baseline assessment, which is an evaluation of the site without further remedial action, is also a detailed evaluation of the no-action alternative. The remaining alternatives must be evaluated in a The first step is the development of target ations. These target concentrations are two-step process. chemical concentrations. numerical criteria which are used to judge conformance with ARARs which do not define specific levels. The target concentrations or action levels help to define design goals for the remedial action and are used as points of comparison to the baseline evaluation. The second step is the assessment and comparison of the short- and long-term risks to public health the environment caused by implementation alternative. In this step, the degree to which each alternative meets ARARs will be assessed. Steps similar to those discussed for the baseline will be used in these evaluations. selection of target chemical concentrations will selection of indicator chemicals, identification of exposure pathways, and selection of the target concentrations. Selection of target concentrations will be based on ARARs, if they are available, or calculated using toxicity and chemical intake data developed during the baseline assessment. If offsite land disposal or containment is considered, the potential threat to human health and the environment from the excavation, transportation, and redisposal or containment of hazardous contaminants will be assessed.

A.5.2.3 Environmental Assessment

The environmental evaluation (also part of Task 6) will focus on the site problems and the contaminant pathways actually addressed by the alternative. This assessment will determine to what degree the alternative will protect and improve the environment. Adverse environmental impacts resulting from implementation of the alternatives will be fully described. Known environmental problems not addressed by the alternative will also be described.

The level of detail in the environmental assessments will depend on the degree of actual or potential damage to the environment being evaluated. A detailed assessment will be performed for the no-action alternative. This assessment will idem AGO (10597) extent of currently or potentially contaminated areas, identify possible environmental effects, and evaluate the significance of such effects. Other alternatives will be assessed in detail if

adverse environmental effects are expected to occur as a result of the response action.

A.5.2.4 Attainment of ARARs

ARARS must be considered during the detailed evaluation of alternatives. Prior to the ARAR conformance evaluation, site-specific and alternative-specific ARARS will have been defined. For site-specific ARAR evaluation, action levels may be developed, if possible, to provide specific numerical criteria. During the detailed analysis step, each alternative must be evaluated on the extent to which it attains ARARS.

A.5.2.5 Cost Evaluation

A detailed cost analysis will be performed for each alternative and will consist of the following steps:

- Estimate capital and operation and maintenance costs (including long-term maintenance costs).
- Calculate annual costs and present worth.
- Evaluate the sensitivity of cost estimates to changes in key parameters such as discount rates, design, or effective life.
- Estimate 5-year evaluation costs.
- Assess the potential for future remedial action costs if the remedy fails (replacement costs).

For each alternative, the cost will be estimated within a range of -30 percent to +50 percent. The cost analysis will include separate evaluation of capital and operation and maintenance costs. Capital costs will consist of short-term installation costs such as engineering/design fees, materials and equipment, construction, and offsite treatment or disposal. Operation and maintenance costs will consist of long-term costs associated with operating and monitoring the remedial actions. Capital and annual operation and maintenance costs will be based on the anticipated time necessary for the alternative to achieve cleanup criteria.

A discount rate of 10 percent will be assumed for all present worth calculations. Cost estimates will be prepared using data from project files, the current EPA Remedial Action Costing Procedures Manual, USEPA technical reports, and quotations from equipment vendors. Equipment replacement costs will be included when the required performance period exceeds equipment design life.

A.5.3 TASK 11 - FEASIBILITY STUDY REPORT

Task 11 will consist of the following subtasks:

- Summarize each alternative in terms of effectiveness, implementability, and cost.
- Compare the remedial alternatives.
- · Prepare the Draft and Final FS report.

The FS Report will include an executive summary, an introduction, a description of the screening and evaluation process, a summary of the detailed technical and cost evaluations, and a comparative evaluation of the remedial alternatives. This summary will be presented as table matrices. Backup information and calculations will be included as appendices.

A.5.4 TASK 12 - POST RI/FS SUPPORT

The REM III Team will provide support to EPA following completion of the Croydon TCE Site Phase II RI/FS. This support will include community relations, preparation of the Record of Decision and Responsiveness Summary, assistance to the U.S. Army Corps of Engineers or other parties involved in the remedial design/remedial action, work assignment closeout, and briefing support.

A.6.0 PROJECT MANAGEMENT APPROACH

A.6.1 ORGANIZATION AND APPROACH

The proposed project organization for the Croydon TCE RI/FS is Figure A.6-1. The Regional Manager Mr. Richard C Evans, is responsible for the quality of all REM III work performed in Region III. Mr. Raymond P Wattras will serve as the Site Manager (SM). The SM has primary responsibility for implementing and executing the RI/FS. Supporting the SM are the Field Operations Leader (FOL), the FS Leader, the RI Leader and other technical support staff. FOL is responsible for the onsite management of activities for the duration of the site investigation. The RI leader is responsible for the implementation of the RI and preparation of The FS Leader is responsible for the the RI report. implementation and preparation of the FS report.

The Phase II RI/FS tasks included in this Work Plan, in addition to the schedule and budget, comprise the baseline plans which form an integrated management information system against which work assignment progress can be measured. The baseline plans are a precise description of how the work assignment will be executed in terms of scope, schedule, and budget. The project schedule and detailed cost estimate are presented in Sections A.6.3 and A.6.4, respectively.

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A.6.2 QUALITY ASSURANCE AND DATA MANAGEMENT

The site-specific quality assurance requirements will be in accordance with the Quality Assurance Program Plan (QAPP) for the REM III program, as approved by EPA. The REM III QAPP provides general guidance on the following subjects:

- · Project organization and responsibility.
- QA objectives for measurement of data in terms of precision, accuracy, representativeness, completeness, and comparability.

Data management aspects of the program pertain to controlling and filing documents. Ebasco has developed a program filing system (Administrative Guideline Number PA-5) that conforms to the requirements of EPA and the REM III Program to ensure that the integrity of the documents is safeguarded. This guideline will be implemented to control and file all documents associated with the Croydon TCE Site RI/FS. The system includes document receipt control procedures, a file review and inspection system, and security measures to be followed.

A.6.3 PROJECT SCHEDULE

Figure A.6-2 depicts the schedule of tasks and activities for the Croydon TCE Site Phase II RI/FS. The schedule for the field investigation assumes that no site restrictions will be encountered and is dependent upon EPA approval of the Final Phase II Work Plan and the FOP by September 9, 1988.

A.6.4 COST ESTIMATES

The detailed cost estimate for the Croydon TCE Site Phase II RI/FS is presented under separate cover in the Optional Form 60 (OF-60). Costs for CLP analysis or REM III Laboratory Analysis (if required) are not included in the REM III Team total cost. Costs for potential additional investigations, such as treatability study/pilot testing, have not been included in the estimates for this Work Plan.

REM III C CHATELAIN 215-755-0212 CHATELAIN RLSC CLP 412-788-1080 412-788-1080 M SOLTIS K BRADY CHSS SPECIALIST ENVIRONMENTAL/CHEMICAL ENGINEER TASK MANAGER W ISNER 412-788-1080 PEASIBILITY GEOTECH. ENGR. STUDY REGULATORY SPECIALIST TOXICOLOGIST/RISK ASSESS. MODELER REGIONAL MANAGER HYDROGEOLOGIST 215-752-0212 SITE MANAGER 412-788-1080 R WATTRAS CROYDON TCE SITE R EVANS INVESTIGATION 412-788-1080 TASK MANAGER ENV. SCIENTIST R WATTRAS REMEDIAL GEOLOGIST CHEMIST 215-785-8219 215-597-1265 215-547-0517 EPA RPM J WINEGAR OPERATIONS TECHNICIAN S BARNICK GEOLOGIST S DEL RE (Office Trailer) CHEMIST LEADER PIELD RPA REGIONAL COMMUNITY AR300601 RELATIONS LEAD 215-752-0212 C DEITZEL SUBCONTRACTORS DRILLING

PROJECT ORGANIZATION

FIGURE A.6-1

Fig A.6-2 (See back pocket)

EPA REGION III SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID # 11 0 9 2 3 PAGE #AR 300603

IMAGERY COVER SHEET UNSCANNABLE ITEM

Contact the CERCLA Records Center to view this document.

SITE NAME Croydon TCE
OPERABLE UNITOUI
SECTION/BOX/FOLDER Odministrative Record-Section Volume IIIA - Fileron
REPORT OR DOCUMENT TITLE Final Phase I (RI) Report DATE OF DOCUMENT
DESCRIPTION OF IMAGERY Thase I Monitoring well
NUMBER AND TYPE OF IMAGERY ITEM(S) 1 Oversized Map

EPA REGION III SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID # 110923 PAGE #AR 300604

IMAGERY COVER SHEET UNSCANNABLE ITEM

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SITE NAME Croydon TCE

OPERABLE UNIT	001	
SECTION/BOX/FOLDE	Radministrative Record-Sect Volume IIA - Filencom	Hon
REPORT OR DOCUMEN	ENT TITLE <u>Final Phase I (R1</u> r 5/9/88	.) Report
	AGERY Phase II RI/FS Pr	oject
	of imagery item(s) 1 Oversiz	ed Map

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APPENDIX B

DESCRIPTION OF POTENTIAL TCE SOURCE AREAS

Note: The description of potential source areas was taken from the following document:

USEPA, 1985. <u>Site Analysis - Rohm and Haas LAMBRILD GARB</u>
Vicinity, Bristol, <u>Pennsylvania</u>. Environmental Monitoring
Systems Laboratory, Las Vegas, Nevada. (TS-PIC-84019).
January 1985.

Figures 2-12 depict activities observed at the preselected sites under study in this report.

SITE 1 (Figures 24-3)

1940 (Figure 2A) - The site is a rectangular open field bordered by dirt roads to the north, east and west and by 1.S. Route 13 (Bristol Pike) to the south. A pond, fed by an unnamed creek, is in the northeastern corner. One or more small buildings (3), probably residential, are clustered on the northern edge of the field.

1951 (Figure 2B) - Three billboards are present onsite. No other significant changes are noted.

1958 (Figure 2C) - The pond has been filled, leaving only a stream channel along its former northern edge. The filled pond area has revegetated and a few light-toned ground scars (GS) are present. A new (since 1951) dirt access road forms a loop from U.S. Route 13 to the edge of the filled pond area and back. Several possible dark-toned ground stains (GST) are visible on the new access road. A row of unidentifiable, light-toned objects is visible in the southeastern corner of the site. The cluster of buildings seen in 1940 and 1951 appears abandoned, as the access road to them is covered by shrubs and trees.

1962 (Figure 2D) - Imagery was available for only the eastern half of the site. In this portion, three circular features (approximately 12-15 meters (39-49 feet) in diameter) are visible, each tangentially bordered by two diametrically opposed, very light-toned rectangular objects. Mottled pround scarring appears around the easternmost circular feature. Dark-toned possible ground stains are seen in the filled pond area. The widened stream channel in this area indicates probable fill material erosion. Three huildings are located near the southern border (U.S. Route 13). No access roads are onsite.

1970 (Figure ?E) - The circular ground scars seen in 1962 are no longer present. In the eastern half of the site, an open storage area (possibly for lumber) can be seen. Two buildings and a dark-toned probable ground stain, possibly from a wood treatment operation, can be distinguished. In the western half, there is a large excavation area (EX) containing light-toned (LT) mounded material (MM) and a vehicle (V). Probable ground stains are visible around the perimeter of the excavation area. To the west of the excavation area are rows of medium-toned mounded material.

1974 (Figure 2F) - The bulk of the open storage area seen in 1970 is no longer present. A building, four trucks, two trailers and two possible small sheds (none of which are annotated) are still visible on the 1970 location. Northeast of that area, a dark-toned possible around stain is visible. The filled pond area shows continued signs of fill material erosion (first poted on the 1962 imagery). A facility with one building and numerous semi-trailers on onsite is visible where the excavation area was seen in 1970. Several dark-toned ground stains are visible on and off the facility grounds. A

trench (TEL) is visible along the facility's eastern border. The medium-toned mounded raterial seen in 1970 is still visible; in addition, 40-50 similar-looking mounds now appear in several rows in the center of the site.

1979 (Figure 2G) - The facility seen in 1974 appears little changed; it is slightly expanded with scattered dark-toned ground stains (not annotated). The medium-toned mounded material, seen in two areas in 1974, is no longer visible. The eastern half of the site has revegetated, except for dirt roads or trails that crisscross the area and a large, very light-toned bare area. The roads/trails appear well-traveled and several lead to the bare area. They do not appear to be connected with either the facility to the west or the activities of the building east of the site; they are possibly used by minibike and motorcycle riders.

West of the facility is a light-toned area, nossibly a mound. Two access roads lead to it, one from the facility and the other from a facility west of the site.

SITE 2 (Figures 3A-F)

1940 (Figure 3A) - The site appears as part of an open field and contains two residences (not annotated).

1951 (Figure 3B) - A large dark-toned (DK) area extends from the center of the site to the southeast corner, onto the property of the adjacent 'wens-Illinois' facility. The origin and nature of this feature are not discernible from the imagery; the possibilities include ground staining, spreading of dark-toned material, a burn area and vegetation cover. To the north of this area is a hump-shaped formation of earthen material with probable vehicle tracks running across it. This hump-shaped formation extends from the western boundary of the Owens-Illinois facility to an onsite area appearing as a probable medium-toned ground stain. A trench extends northwest, from the northwest corner of the Owens-Illinois building, onto the site with no apparent outlet. The number of residences onsite has increased; they continue to increase in number throughout the years of analysis and will not he further mentioned.

1958 (Figure 3C) - Of the features seen in 1951, the dark-toned area, hump-shaped formation and medium-toned ground stain are no longer seen and the trench is only faintly visible. Along the eastern boundary is an impoundment (IM) containing standing liquid.

1962 - No photo coverane of the site was available.

1970 (Figure 37) - The impoundment seen in 1958 is no longer visible. Ditched drainage runs northward along the eastern border. Most of the site, except for the residential strip along the western boundary, now supports shrub and young tree growth.

1974 (Figure 3E) - The drainage ditch has been moved to the North allow for expansion of the Owens-Illinois facility onto the site. AR300008

1Collateral information, EPA Pegion 3.

1976 (Figure 35) - No significant changes are noted. Petween the residential area and the drainage ditch, the site is mostly tree-covered.

SITES 3 AND 4 (Figures 4A-G).

Sites 3 and 4 are analyzed together due to their proximity to each other. Site 3 is described as a "railroad truck" fabrication facility. Site 4, a flare manufacturing facility, includes an adjacent excavation area prior to 1970. This excavation area is later covered by a large warehouse.

1940 (Figure 4A) - Each site contains several buildings and small sheds. The number of buildings for each site changes, generally increasing, throughout the years of imagery, and no further mention of them will be made unless relevant. Both facilities are accessible from State Road by the same access road. A separate access road services the adjacent excavation area from State Road. No access roads directly connect the facilities' buildings to the excavation area. A narrow pool of medium-toned standing liquid (SL) lies along the western edge of the excavation floor. At the northern end is a dark-toned area with possible mounded material. An extraction area (EXT) and possible light-toned mounded material lie south of the dark-toned area. A film defect is visible north of the excavation area and extends into the dark-toned area.

1951 (Figure 4B) - No significant changes are noted on Site 3.

The excavation area seen on Site 4 in 1940 has been extended northward and will be referred to as the main excavation. A second, smaller and shallower excavation appears adjacent to and west of the main excavation and will be referred to as the western excavation. Access to the two excavation areas is separate; the access road to the western excavation originates from the adjacent Owens-Illinois facility (to the west).

In the main excavation, dark-toned standing liquid covers nearly half of the excavation floor. Approximately 50-60 mounds of light-toned material are in the southwestern corner and along the western wall. West of Building 1 (B1) on Site 4, light-toned material (M) trails down the main excavation wall and forms a pile on the excavation floor.

The western excavation contains a pool of light-toned standing liquid surrounded by dark-toned probable ground staining. Light-toned liquid appears to be flowing into the pool from a dark-toned object, possibly a drum or pipeline outlet.

[Collateral information, EPA Region 3.

1954 (Figure 4C) - No significant changes are noted on Site 3.

Park-toned possible ground stains are visible in the southwestern corner of the facility grounds on Site 4. Dark-toned standing liquid is present in the main excavation on Site 4, in the same areas seen in 1951; however, the liquid appears much shallower, covering approximately one-sixth of the total hottom area (versus one-half in 1951). Shrubs and low vegetation cover most of the bottom and sides; however, the access road appears vegetation-free from State Road to the excavation center, indicating possible recent use. The light-toned mounded material seen along the western wall of the main excavation in 1951 appears eroded. The trail of light-toned material that was located behind B1 in 1951 is still visible, and the pile of light-toned material on the excavation floor directly below has increased in size. Little vegetation occurs on this pile, possibly indicating recent activity.

In the western excavation, further excavation appears to have accurred, including removal of a portion of the wall between the main and western excavations. Dark-toned standing liquid appears where light-toned standing liquid was seen in 1951. The dark-toned object seen in 1951 is visible, again with liquid appearing to flow from it to the pool of standing liquid. The access road from the Owens-Illinois facility, seen in 1951, has revegetated.

1962 (Figure 4D) - No significant changes are noted on Site 3.

Southwest of the facility on Site 4, disturbed ground and a trench are visible. The trail of light-toned material that ran down the main excavation wall behind R1 in 1951 and 1958 is no longer distinct. In the main excavation, over 100 light- and medium-toned mounds of material have been added along the western wall. Standing liquid appears to cover nearly one-half of the bottom area and is bordered by shrub vegetation. Dark-toned possible ground stains or standing liquids are scattered throughout the non-vegetated areas.

In the western excavation (as previously seen in 1951), light-toned standing liquid appears, surrounded by dark-toned probable standing liquid or ground staining. The dark-toned object seen in 1951 and 1958 is visible, although no liquid appears to be flowing from it. Little vegetation is seen, and dark-toned ground stains are present.

1970 (Figure 4E) - No significant changes are noted on Site 3.

A ground scar is visible southwest of the Site 4 facility where the disturbed ground was seen in 1952. The main excavation area, including the access road, is almost entirely covered by vegetation, interspersed with dark-toned standing liquid. Mounds of material are visible along the western wall and access road.

In the western excavation, a pool of dark-toned standing liquid is visible. The remainder of the area, to the south, has been further excavated downward to the level of the main excavation floor and is littered with dark-toned debris (DB) and dark-toned probable ground stains (not annotated) 610 The dark-toned object is still visible.

1974 (Figure 45) - On Site 3, several dark-timed possible ground stains and a small excavation area are visible in the northwestern corner. The excavation area may be incidental to the construction of the adjacent industrial building.

Four industrial buildings have been built adjacent to the buildings of Sites 3 and 4 and are directly over both of the excavation areas, completely covering any signs of their former existence. These new structures are located directly over both of the former excavation areas, which were apparently filled sometime after 1970.

1978 (Figure 4G) - Probable ground staining is visible on Site 3; the excavation has been filled and revegetated.

Wo significant changes are noted on Site 4.

SITE 5 (Figures 5A-G)

1940 (Figure 5A) - The site is an agricultural field.

1951 (Figure 58) - No significant changes are noted.

1958 (Figure 5C) - No significant changes are noted.

1962 (Figure 5A) - Two large hump-shaped mounds of earth-like material, possibly sludge from the nearby water treatment plant (WTP), appear in the site's southwestern corner. Possible ground staining is visible in the vicinity of the mounds. The light-toned area seen in the eastern portion of the site is possible mounded material or disturbed ground.

1970 (Figure 5E) - The two hump-shaped mounds seen in 1962 are no longer visible; a possible remnant of one of the mounds, probable ground staining and around scarring are visible in the southwestern corner of the site. Most of the site appears as a graded area. Railroad tracks pass through the western portion of the site.

1974 (Figure 5F) - A large hump-shaped mound of earthen material, similar to those seen in 1962, is onsite. The northwest portion of the mound appears to have been duq out and removed, leaving a shallow depression that contains a dark-toned standing liquid. A ridge, possibly a dike, runs along the northeastern corner of the site, bordering the road. Ditched drainage leads to the northwest from the northeast corner. Dark-toned probable ground stains are present. The southwestern corner has revenetated with faint ground scarring.

Mortheast of Site 5 is an area with a ridge, probable ground staining and ground scarring similar to that seen on Site 5.

1978 (Figure 5G) - The hump-shaped mound seen in 1974 appears to have been removed. An irregularly shaped mound of light-toned material, possibly a remnant of the 1974 mound, remains. The ridge and standing liquid seen in 1974 are not present; the ditched drainage and much of the probable ground staining remain. A fence, which now surrounds the water treatment plant, extends 0 to 1 the southern portion of the site. The site as a whole appears as a sparsely vegetated, graded area.

The area northeast of Site 5 seen in the 1974 imagery has completely reveretated except for an area of ground scarring. Possible ground stains are also visible.

SITES A AND 7 (Figures 6A-G)

Sites 6 and 7 are analyzed together due to their proximity to each other. Site 6 is described as Scorpio Industries, whose present operations are unknown. Site 7 is described as a possible truck repair facility.

1940 (Figure 6A) - Site 6 appears as a wooded area. Site 7 consists of two buildings and a possible shed. The drainage annotated is a tributary of an unnamed creek which flows southwest into the Delaware River. No other significant features are noted.

1951 (Figure 68) - Site 6 shows no change. On Site 7, several probable dark-toned ground stains are visible.

1958 (Figure 6C) - Site 6 shows no change. On Site 7, all but one of the ground stains seen in 1951 are no longer present. Two possible light-toned mounds of material are visible onsite.

1962 (Figure 6D) - Site 6 shows no change. On Site 7, several possible dark-toned ground stains are visible.

1970 (Figure 6E) - Site 6 is a cleared lot with ditched drainage on the northwestern border. The clearing activities on Site 6 have disrupted the drainage pattern in the vicinity of the two sites. The operations on Site 7 appear to have expanded with increased building space and the presence of numerous vehicles, mostly trucks (not annotated). The possible ground stains seen in 1962 are no longer distinctly visible, possibly due to shadows; however, probable dark-toned standing liquid is present. Possible junked vehicles lie to the northwest. Possible ground staining is visible in the open area southwest of Site 7.

1974 (Figure 6F) - Site 6 contains a large building with a parking lot. Two dark-toned ground stains, originating at the northwestern edge of the building, extend northwestward across the parking lot to a drainage ditch, which contains a dark-toned liquid. On Site 7, probable dark-toned standing liquid and a drainage ditch are visible. Scattered refuse (R) is visible to the northwest where possible junked vehicles were seen in 1970. In the open area southwest of Site 7, there are areas of probable dark-toned ground staining (as seen in 1970) and light-toned mounded material.

1978 (Figure 5G) - Much of the area northeast of Site 6 has been cleared of trees; ground scars and dark-toned ground stains are visible in this area. Dark-toned standing liquid is visible in the drainage ditch on Site 6; and dark-toned ground stains, similar to those seen northeast of the parking lot on Site 6, form a trail southwest of Site 6.

1Collateral information, EPA Region 3.

In the probable standing liquid seen in 1974 is no longer visible. Light-toned mounded material is present and refuse is strewn about the slope to the northwest. The drainage ditch leading northwest from Site 7 is less distinct than seen in 1974. In the open area southwest of Site 7, the mounded material seen in 1974 is no longer visible, but probable ground stains remain.

SITE 8 (Figures 74-G)

The building onsite is currently a VFW post 1 ; its prior uses are unknown.

1940 (Figure 7A) - Multi-toned refuse (type indeterminable from the imagery) is scattered southeast of the building on the slope that leads down to a pond. The refuse is present, in varying quantities, in every year of analysis and will not be further mentioned. Several possible dark-toned ground stains are visible north of the building. A possible boat or platform lies in the southwestern corner of the pond. Several film defects are present southwest of the site.

1951 (Figure 78) - The possible ground stains and possible boat or platform seen in 1940 are no longer present. A probable vehicle is present.

1958 (Figure 7C) - No significant changes are noted.

1962 (Figure 7D) - Light-toned mounds of fine-textured material are visible on the slope at the cond's edge. Dark-toned possible standing liquid with a trail leading to the pond is seen in the site's southwestern section. Numerous vehicles are visible northwest of the building.

1970 (Figure 7E) - The piles present in 1962 are no longer visible. A probable dark-toned ground stain lies southwest of the building where the nossible standing liquid was seen in 1962. An additional dark-toned probable ground stain is also visible in this area.

1974 (Figure 7F) - The probable ground stains present in 1970 are no longer visible. One vehicle is present onsite.

1978 (Figure 7G) - Several possible dark-toned ground stains are visible in the immediate vicinity of the building. The pond has almost completely dried up; refuse can be seen in the dried-bed area of the pond to the north. One vehicle is onsite.

¹Collateral information, EPA Region 3.

SITE O (Figures 9A-G)

Site 9 is described as a commercial structure containing several small businesses.

1940 (Figure 8A) - The site appears as a semi-whoded lot. The drainage nattern does not change significantly throughout the period of analysis and will not be further annotated.

1951 (Figure 8B) - No significant changes are noted.

1958 (Figure 8C) - No significant changes are noted.

1962 (Figure 8D) - No significant changes are noted.

1970 (Figure RE) - No significant changes are noted.

1974 (Figure 9F) - A building and a parking lot containing several vehicles (not annotated) are present. Debris, probably construction-related, appears in the immediate vicinity and southeast of the building.

1978 (Figure 8G) - The debris present in 1974 is no longer visible, and the corresponding areas have revegetated. No additional significant changes or features are noted.

SITE 10 (Figures 9A-F)

1940-1978 - Site 10 is described as a metal tubing manufacturer, now apparently closed. Probable dark-toned ground stains are seen onsite for all years of imagery. No other significant features were noted for any year analyzed. The site was not covered on available 1962 imagery.

SITE 11 (Figures 10A-G)

1940 (Figure 10A) - The site is an open field, probably agricultural. A film defect extends through the site.

1951 (Figure 108) - An access road is present on the southern and eastern borders of the site.

1958 (Figure 10C) - Light-toned ground scars are present in the southern section of the site. Electric power line structures are visible to the northeast. They are present in all subsequent years of analysis and will not be further annotated.

1962 (Figure 100) - No significant changes are noted. Two film defects are present.

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1Collateral information, EPA Region 3.

1970 (Figure 10E) - A pit (P) is visible northeast of the light-toned ground scars first seen in 1958. A very light-toned standing liquid is seen at the bottom of the pit. An access road leads to the pit. Southwest of the pit is a ground scarred area with an irregularly shaped mound of material. A probable fence or dike surrounds both areas.

1974 (Figure 10F) - As seen in 1970, the pit with standing liquid (now smaller) and ground scarred area (showing signs of excavation activity in the previous area of the mounded material) are still visible. A similar but larger new pit is seen to the northeast. Very light-toned standing liquid also lies at the bottom of the large pit, and an apparent overflow drainage channel runs southwest from the pit's southern corner. The large pit is serviced by an access road, and vehicle tracks can be seen leading to its edge. Medium-toned mounded material is present just west of the pit area. Northeast of the large pit is a ridge of earth-like material, possibly sludge. The probable fence or dike seen in 1970 is no longer present, but a similar structure nearly encloses the large pit and the nearby mounded material.

1978 (Figure 10G) - None of the features seen in 1974, except the access roads, are present. Most of the area southeast of the access road bisecting the site appears to have been covered by light-toned earth-like material. Large possible ground stains of various tones appear throughout the area.

SITE 12 (Figures 11A-G)

1940 (Figure 11A) - The entire site is an agricultural field. Southeast of the site are rows of mounded material.

1951 (Figure 11B) - No significant onsite changes are noted. The mounded material seen in the 1940 imagery appears eroded and/or covered by vegetation.

1958 (Figure 11C) - The two large treatment basins of a water treatment plant are first seen northeast of the site. In the southwestern portion of the site, three dark-toned, circular ground scars (approximately 36 meters (117 feet) in diameter) are arranged in a triangle. This portion of the site does not appear to be used currently for agriculture. The mounded material seen in the 1940 and 1951 imagery is not visible; it likely has been inundated by the lagoon.

1962 (Figure 11D) - A series of trenches is visible in the southwestern portion of the site; most contain dark-toned standing liquid or ground staining. They are accessible from a newly present access road which runs through the site. Two smaller tanks and two rectangular excavations, probably lagoons or sludge drying beds, have been added to the water treatment operation. Disturbed ground lies southwest of the excavations, and a cleared, vegetation-free area lies north of the trenches. The circular ground scars seen in 1962 are no longer visible due to the trench construction.

1970 (Finure 11E) - Disturbed ground covers the area where trenches were seen in 1962. A new series of trenches lies just southwest of the rectangular excavations. All of the trenches contain dark-toned standing liquid or ground staining. The excavations contain dark- and very light-toned standing liquid, residue or ground staining. These observations concerning the excavations occur in all subsequent years of analysis and will not be mentioned further. Several vertical tanks are visible in the southwestern portion and are connected by pipeline to the Rohm and Haas Croydon Plant (not annotated). The vertical tanks are present throughout the remainder of the period of analysis and will not be further annotated.

1974 (Figure 11F) - The trenches seen in the 1970 imagery exhibit little probable dark-toned standing liquid or ground staining, and it is not apparent that they are currently in use. The northeastern excavation seen in the 1970 imagery has been subdivided into eight impoundments. The disturbed ground seen in 1970 (covering the trenches seen in 1962) has not revegetated. Approximately twelve semi-trailers are present in the southwest portion of the site.

1978 (Figure 11G) - The trenches seen in 1970 and 1974 show little change from 1974. Northwest of the trenches is an area of probable ground staining. Southwest of the trenches are numerous mounds of light-toned material. The disturbed ground area of 1970 and 1974 has revegetated. Semi-trailers, possible sheds and an extension of the Rohm and Haas Croydon facility are also present in the southwestern section of the site. One-half of the southwestern excavation has been subdivided into four impoundments.

SITE 13 (Figures 12A-F)

1940 (Figure 12A) - The site is a semi-wooded area with several trails through it. Trails appear onsite throughout the period of analysis and will not be annotated.

1951 (Figure 128) - No significant changes are noted.

1958 (Figure 12C) - No significant changes are noted.

1962 - The site was not covered by available photography.

1970 (Figure 120) - The site has been cleared of trees and shrubs, and two haseball diamonds are visible. Mounds of material, probably soil, lie along the site's eastern and southern boundaries and are probably a result of the clearing activities.

1974 (Figure 12E) - A building has been erected in the northwestern corner. The southeastern corner appears striated, possibly a result of clearing activity or grading of the mounded material seen along the southern border in the 1970 imagery. The striations may have been present in 1970, but the poor quality of the 1970 photography prevented their detection. Trails through the site appear to be the result of motorcycle activity, although an automobile or truck could use them. Unidentifiable refuse is visible in the southwestern corner. The mounded material seen in the 1970 imagery along the 6 16 mastern border is still present.

1978 (Figure 12F) - Two additional baseball diamonds (not annotated) are present. The mounded material seen in 1970 and 1974 is no longer visible: it may have been used in construction of the fields. The striated area seen in 1974 has revegetated; the striations are no longer visible. Possible dark-toned ground staining is visible in the southwestern corner where refuse, still present but not annotated, was seen in 1974. The building and trails seen in 1974 remain unchanged.

APPENDIX C

TIDAL FLUCTUATIONS - DELAWARE RIVER

APPENDIX C

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TIDAL PLUCTUATIONS - DELAWARE RIVER CROYDON TCE SITE

Stat	ion No	Station No. 1917, Philad	Philade.	elphia, PA(1)	A(1)	Stati	on No.	1928,	Station No. 1928, Burlington, VT(2,3,4)	on, VT(2	,3,4)
1,50	(High	High Tide	Low	Low Tide	0460		High	High Tide	Low	Low Tide
המרפ	ע	Time	Height	Time	Height			Time	Height	Time	Height
Jan. 4,	1988	01:33	0.8	08:21	1.0	Jan. 4,	1988	03:00	2.2	10:03	0.1
		13:52	6.1	21:06	1.0			15:19	6.3	22:48	0.1
Jan. 5,	1988	02:17	5.0	09:03	0.2	Jan. 5,	1988	03:44	5.2	10:45	0.2
		14:34	6.1	21:48	0.2			16:01	6.3	23:30	0.2
Jan. 6,	1988	03:00	2.0	09:45	0.2	Jan. 6,	1988	04:27	5.2	11:27	0.2
		15:15	0.9	22:27	0.2			16:42	6.3		
Jan. 7,	1988	03:44	5.0	10:25	0.2	Jan. 7,	1988			00:19	0.2
		15:55	6.3	23:06	0.2			05:11	5.2	12:07	0.2
								17:22	6.1		
Jan. 8,	1988	04:24	5.0	11:07	0.2	Jan. 8,	1988	•		00:48	0.2
		16:36	5.8	23:44	0.2			05:51	5.2	12:49	0.2
								18:03	0.9		
						Jan. 9,	1988			01:26	0.2

of Commerce, Coast East of Including Greenland, U.S. Department and Low Water Prediction, High 1988, America, Tables, and South Tide 1987, pp. 289. North NOAA, Sources

(1) Station No. 1917: Latitude 39°57', Longitude 75°08'
(2) Station No. 1928: Latitude 40°05', Longitude 74°52' (Subordinate Station)
(3) Times at the subordinate station are adjusted by +0127 hours for high water and by +0142 hours for low water.
(4) Heights at the subordinate station are adjusted by +0.2 feet for high water and by

N+0.0 feet for low water.

APPENDIX D
MONITORING WELL BORING LOGS

SON, TERMS

COARSE GRAINED SOILS Lord Roce Dures Group Strain Lands Income the Coarse Coar	LEGEND	SOIL SAMPLES - TYPES	5 - 2" O.D. Spile Bossel Sample 51 - 3" O.D. Undistanted Sample O-Other Sample; Specify in Formarts ROCK SAMPLES - TYPES		R. WK (Conventioned) Core (~2.16" O D	Q - HQ (wheelme) Care (~1 : Ma = 0 D) 2 - Other Care Sires, Specify in Remarks	WATERLEVELS	1376 Paris Land Library & Section 19 Section	900	V 12.6" Stabilised Lovel "Date & Dept				
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CET STATES CHAM CHANGE CHAM CHANGE CHAM CHANGE CHAM CHANGE CHAM CHANGE CHAM CHANGE CHA		SORS and	GROUP SYM- BOL	1	A S	8	Æ	ક	3		\$	SM		×
CETANOS CLEAN CONVERS STATISTO			ENTIFICA (10M PROCEDURES 9 particles larges (has 3" & basing friens on estimated weights)	L			,			***************************************				Party from the standard and the standard
			FIELDIO	-	NY NY	Crest	\$13 \$13	NIA. VANS	+	SON'	75 13 1 > 1			

general descriptions for provided for the grant of the grant of the grant of the committee of the co

			,
DENSITYO	DENSITY OF GRANILAR SOILS		
DESIGNATION	STANDARD PENETRATION RESISTANCE - BEOWSHOOT		
Very bose	3		
la os	2,5		
Medium dense	2:		
Danie Orași	8 i		•
very dense	210		
	A		

	CONSTRUCT	CONSISTENCY OF CONESIVE SOILS	
COMSISTEMEN	UNC. COMPRESSIVE STR. TONSASO, FT.	STANDARD PENETRATION RESISTANCE - BLOWS-FOOT	FRED EDENTIFICATION SEETINGE
Very saft Soft Seif Tard	Lent (hen 0.25 0.25 to 9.0 0.26 to 1.0 1.0 to 2.0 2.0 to 4.0	200 200 200 400 800 55 1510 50 90 190	projected with difficulty by filements for the provinced by filement for the provinced by fileme

ROCK TERMS

	ROCK HARDNESS (FROM CORE SAMPLES)	CORE SAMPLES)
Zensta tenses	DESCRIPTIVE TERMS TO SCREWOMPTR DREAME EFFECTS	SADAAA MANNOONA
Modern soft Modern bard Resed	Contractors Contractors Contractors Contractors	gang (jama) gyantai jaganyan sanag gang tana gyang (mang tanag) gang tana gyang (mang tanag) sanag Chayan nusub bassan nuju yawasa

2 4504		
Spenting frames and	ASSERVATION	SPACING
Apong Apong Magang Asia	e e e e	n n n de de de de

23

some around one

mad-coarse sond

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REMARKS	Hollows	tem A	Jaer	·		
•				56112	< Aga -	

Dense

2.0/25

BORING CR-TUDICS

AR300624

PAGE 1 OF 3

* See Legend on Back

.EV. ITAW	ATION: ER LEVI	L DAT			FIE	LD GEO	BORI DRILI	······································	
·	l	r	l	1		MAT	ERIAL DESCRIPTION*	1	
ample RO. LTYPE	DEPTH (ft.)	BLOWS 6" OR RQD (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS		MATERIAL CLASSIFICATION	uscs	REMARKS
	20						3 co Hi		
	2.3			7.C.			•		
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<i>j</i> —			henes		 			اگر _{ود سو} الورورو	

* See Legend on Back

PAGE_1_OF_3

EVA WATE	CT NO ATION: R LEVE				DA	ATE: ELD GEO	BORING N DRILLER:	.ع.	المعجبة لاحدد
SAMPLE NO. B TYPE	GEPTH (ft.)	8LOWS 6" OR 800 ("+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
	S 4		•						
		7	2.0/				med-cause sand w/		= 21.102-1
	23	15 27	2.0/0.0		Lease	74-	arand	Su	
5-7	35	37		Clay		Yelow	silty clay	CL	
	31								-21500
				1					
-8	34	19	1.9/		Very	Tan-			
	3.5	57			Dense	Yellow	mediazinel found	42	nelicorted
	36								ne leaster
	<u> </u>						te, gravel, te, sitt		
		7		ı					
	39	21	1.450		Cehso Cehso	Brown			en e
-9	1.5	59 79					med to coarse grained		Qtz sand
	41						sand		
			·						
		17	2.0/		Manue	Br.			
	44	22	2.0/2.0		Cense	31.	coarse sand w/	5w	3xx ·silly-and
3-10	-5	31					lenses of clay, fine		brown - sithesage
	46						silty sand, and		grey clay, white
·			· .] .			dean coarsecand		and
	49	21	2%0		\s~		med sand, ne		- co fines, mas
5-11	50	39			مديد		gravel or coubbles		AR300627
LEMAI		94.	- 11/3	5/87			grant or coons	<u>-</u>	BORING 25.11.13

PROJE LEVA WATE	CT NO LTION: IR LEVE	L DATA	0217 A: 15.0	 2 7 4	DA FIE	ATE: , ELD GEO	BORING 6 27 DRILLER OGIST: ことっこ	. L L	ມລວນ ເລ.
		BLOWS	SAMPLE			MAT	RIAL DESCRIPTION		
SAMPLE NO. & TYPE	OEPTH (M.)	6" OR RQB ("+)	RECOVERY SAMPLE LENGTH	LiTHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	yscs	REMARKS
				1 1					
	-								
		g	30%0		med	white		-	0,
5-/2	54 55	13	80		med	*400	med-coarse sand	SP	well sorted
	36						minh que grains,		Fines may have be
							· no fine, magnet		wast or by Ebst
<u>5-13</u>	59	ا م	-		100 K 80				C1 C1
	60	14 60	`					50	Sample fell out
	101							+	of this fo
									No recover
	64	7	1.0/20			", K			- kidite zere
514		88 41			DENSE	- 1		50	0.0
	66				• •				
	,		 						
		15	1.5/			A Art Transition			
	69	38 18	1.8/20		Nery Dense	Silver	<u> </u>	+-	<u></u>
s · 15				T.g.			Weather ed Befrock	1-	
				70'			micaccaus		
						- 1			
		<u> </u>	}						R300628

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VATER Date,	LEVEL	DATA	0 6.70 1	£	FIE	LD GEO	BORIN DRILLI	ER: Karl	A 1 1 =
VATER Date, '	LEVEL	Cond	3 '	T. 1. 2	۱۰۰۰ است مقال ما	LD GEO			- 11.56 cerier
Date,	Time &	Cond			for the care	2	LOGIST: Z. Carolik		
IMPLE NO.	OEPTH							1	
NO.	OEPTH	BLOWS							
NO.		BLOWS 6" OR 800 ("+)	SAMPLE RECOVERV SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.)		MAT	RIAL DESCRIPTION*	_	REMARKS
					SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	
	-								
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								╼╂╼╾╂	
L							See paring log		
						, s	re-moids(D)		· · · · · · · · · · · · · · · · · · ·
-							Sac Vithobair		
	-						for lithologic description.		
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	o.o. L						g*•	1 1	
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	5.0								
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	<u>_</u> _							1 1	
									W.T. 13.2 FT
	 F								
6	20-0				1.				
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				T.O.					
				22'					
				·				- - 	40000000
نل	28.0		L			1.			AR300629
FMADI	KS L			. Α	uger. Samp	٠ .	OIL HAMMER		•

PROJE LEVA WATE	CT NO ATION: R LEVE	L DAT			FIE	ATE: i	BORING 2 11/87 DRILLER LOGIST:	NO.: 6	Cry Wassington
SAMPLE NO. B TYPE	DEPTM (ft.)	BLOWS 6" OR RQD ("+)	SAMPLE RECOVERV SAMPLE LENGTH	LiTHOLOGY CHANGE (Depth.ft.)	MATERIAL DESCRIPTION				
					SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uses	REMARKS HAR
	8.00	A?							/ / / / / / / / / / / / / / / / / / / /
	29.0						•		<u> </u>
5-7		7.	1.7/3		DENSE	5K	med to enarse sand	561	several Flot War
	30.5	. 44					little gravel and-it		ending
							1		- sauting
-8	34.0								
	3,	7.	1.4/15		MED. DENSE	Ba		Sui	No Bigueses 20
	35.5	17							NA BIOWERS OF
									37.5 F= - W: B
			1.0	:					They so
	22.0						V		
-9	:H.O	19	1.5/1.5		DE NIE		Gravel and sand	GP	Orite and schies
	40.5	-17			DE WAS		med to enerse sand	T Gr	
	.0.3						little -: H	1	
							1		
	44.0								
-10		120/3"	_		DENSE			၉၉	Blow-in 0 0
	4.T.S				1.0 E PUD-8				Hard Drilling
	,, <u> </u>						Clay w/ little sand	1	nara mrima
							-ay we little sand	 	
						Cai			
5 -1,	50.5	9	1.5/1.5		ひというど	ERIST		C	1R3006310
ليب	22.5	20	11.5				79		nii 0 0 0 0 1 0 pp

PROJE LEVA	CT NO	 			DA	LD GEOI	OGIST:		DRILLER	: 4	Harriston gazar
		L DATA	A : itions) .								
10010	, , , , , , ,	1	· · · · · · ·								······································
Sample NO. & Type	GEPTH (ft.)	BLOWS 6" OR ROD ("+)	Sample RECOVERY Sample 'LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL GENSITY CONSISTENCY OR ROCK MARDNESS	COLOR		TERIAL IFICATIO	N	uscs	REMARKS
·											
			· ·	1					***		
						1					
	54.0									1	0.6
5-12	34.5	14	1.5/15	1	DEAGE	****	Clev W	11		h	most of Sample
	555	20			O C P C S C	20021			<i>B.F.Z.</i>		exches out uncl
								·		1	ti ones
	2.1							 	<u> </u>	1	r. par
13	5 9.0									1	
7,3	54.0	21		Ì					·	-	
	ట.5	17								-	NO SAMPLE LESS
	29		1.1	1							
				-				<u> </u>		+	
				1						+	
	24.0	11			,					-	
5-15		15		├ ──						1	NO Sande Moker
	103.5						} -			-	· tell on both
			 	1	<u> </u>			<u> </u>		+	si alc
			 	1	 	 				1-	
	69.5	7	1.5/	1				· · · · · · · · · · · · · · · · · · ·	, 1		
5-13		16	1-/-	¶		Gny	weather	- 59	4,5		
· ·	70.5		 	.							
			 	4						-	•
	ļ	 	 							4	
صحيسبي			 	4						1_	000000
	1		1	1						A	R300632

	ER LEVE , Time		itions)					*******	******************
			SAMPLE			MAT	ERIAL DESCRIPTION		
AMPLE NO. TYPE	DEPTH (ft.).	8LDWS 6" GR ROD ("+)	RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	uscš	REMARKS Hi
	SC:								
-									- hitling cobble 26
		120/6	71		Very				
	£ 1.5		15/.5		DENSE				
-7	77 5					R.COMP.		-	a
	.,			•		-	Gravel, cabbles braken	CP	30 boulders
							ittle med-Sinesand		-resistance - Au
-8	24.9	2.5	.5/1.5				andsilt		
		4.5			Very Denie	Cr. Arense	Tribles your	GP	Or
	35.5						coarse sand , some		broken tobaiec
							med graine consi	-	7 years 1"
	€4. ₂	11	2.5/		WED			SP	Anzire + Triest
-3	<u>~1.5</u>	19 R	₽.5		de risé	GN.SA	med, and coarse sand	157	20001: 12 2/A
	40.5				·		ME GOVERNO		
	1	35	2.0		VERY	انوبه. عنصر	is med and ul	30	342 2000
-10		ö٦				<u> </u>	it is correct sord	-	
<u>. · </u>	-60					 	to talakite		
-11	49.0	12	2.%		më D	1.000			
		75			DENIE	الله الله	coarse sand without		AR300635

.

PROJE LEVA WATE	ECT NO. ATION: ER LEVE	L DATA	yden TO 621Y A: itions)		FIE	TE: 11 LD GEO	BORING P 1/12/87 DRILLER: DLOGIST: S. Rachick	G. n	
						MAT	ERIAL DESCRIPTION*		
AMPLE NO. LTYPE	DEPTH (ft.)	(1-) E-OR E-OR	Sample Recovery Sample Length	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY- CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uses	REMARKS HA
	50.5						clay, some biotite	اردع	
							Torus et Sacol		
				,			come din son		
	54.0								
-12			20/20			Tan	med coarse sand	رياخ	- :41055
	S\$. S		,		Sec. 10		w/ 11the sit		
	50.5								
)	22						med grained coop	520	No SAMPLE TAR
	51.						11/4/2 2/14		-more resistant
	1				× .				trilling at 60
									17.11.02
		200	1.5/13		VIC 0 2	OPPAN	3. Hy clay	CL	
-13		20			DENZ		little course sand		
, 15				T.c.			little amplife men		- Slippery feel:
			1	65.					- Juppery sall
									- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
								1	7
			 -				and the second s		
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			 	1				1-1	
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`			 			g and			
* 1 · · · · · *	 			1					
/ _	L	<u> </u>	<u> </u>	<u> </u>	L		L		AR300636
REMA	RKS_		: 						BORING CR. MW

REMARKS hollow stem auger; started 9:01 Am

background HNU: 1ppm, 450: 20.9/0.0/0.0

140 1b harr ner / 30 inch strake.

PAGE_1_OF_2

BORING ER MWOY(

PAGE & OF &

		L DATA	A :.	•••		LDGEO	LOGIST: C.C. K		Carlon Carlos
						MAT	ERIAL DESCRIPTION*		
ample No. B Type	DEPTH (ft.).	ELOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS H N
5-lo		25	2.0/2.0		med	Grown	fine-med sand, tr.	SP	
	\$7.6	14	, ·		Dense		fines, to gravel		Very vell Sorred
	30.0	13	6					ļ	
<u>}-7</u>	S 0 0	43	2.0/2.6	sand silt	Very Dense	Er.	soin clean med.	92	W.7. 21°
	33.0	9:0		. 10	Dense		sine soud		
							cobbles		
. 2	25.5	100	·²/ə.b		Very Dense				0" F
	37.0				Dense		cobbles, sear		cobbles 2"-5"
	1	(3)	1						
-9	39	3 7	9.04		weo	70.0-		-	
. 4	41		2-0/2.5		DENSE	Crown	Coarse sond wisone	(در	we sorted.
							to five sand,		sub angular san
		8		目			11414 514	-	gravel 6 1/2"-1
-10	44	19							
	9		1.0/2.0	, , , , , , , , , , , , , , , , , , ,	DENZE	82 U14	tine sand	SP	
								-	
			-						w.7. 5.3 f4
<i>j</i> 11	So	 		1	[-hit rock		ARARAGE GAL

REMARKS	borine	104	Stam.	CR-MWASH			
•	Hollow						
	1401	<u>H</u>	ammer	filaz.	Sanar	Samole	

2-1

Beard and Cand

Unite silt

BORING CR-MWOSIS

* See Legend on Back

Very

1.4/1.5

PAGE 1 OF 2

PROJE LEVA WATE	CT NO ATION: R LEVE	L DAT	621Y A:		DA FIE	TE: 1.6 LD GEO	BORING J. 1.87 DRILLER LOGIST: S. Carolis K.	: Ei	
					<u> </u>		ERIAL DESCRIPTION*	1	
iample No. B Type	DEPTH (ft.)	(*s) #00 #10#S	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
	65.5	·i				1949			
								+-+	
. , .	29.0			T.E.			•	1-1	
-7		55 53	1.8/1.5	2861	DENZE	Br.	Gravel and madize	س	
	30.5	23						+-+	
						``		++	
					. 4,7				
_								+-+	
					# 10 Per				
								+	
					- 2			++	
•									
								++	
				1					
		 						-	
*	-		}	1				++	
		 		1 .				A	300642

REMARKS Hallow Stem Auger , 8" a.C. 140	In hammer
30 inch iteate	

Red.

Very

Dense

BORING במ-חשים שנו

* See Legend on Back PAGE_L_OF_3

Grand and Sand

little silt

		LOG				<u> </u>			NUS CORPORATION
ROJE AVA. BTAV	CT NO. LTION: ER LEVE	L DATA	A E	•••	DA	ATE: AL	(12/27 LOGIST:] <u>L</u> or,	. DRILLER:	L'andres en la
						MAT	ERIAL DESCRIPTION*		-
IMPLE NO. TYPE	DEPTH (ft.)	ELOWS 6" OR ROD ("+)	SAMPLE RECOVERY SAMPLE LENGTM	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION		REMARKS
	26								
·							No.		
						-	 		
2	29	54 68	11.5		Very	و د	and and med	عود اهس	
_	305	عد ا			Derse		sand to -i	#	
_						· · · · · · · · · · · · · · · · · · ·	<u></u>		
_									
,	<u> </u>		1.5			Br.			
-	ر ہیں : :	22	1.5		very		Sand wil same	Janne I Sm	mod graiced to
					Dense				(-10-4-1)
						eed-			
	33.5	15	1.5/.5		WE C	e	med arained	sand Sp	car deille
- 7	40 5	77					te gearel	+c	•
							2) 1+		
		12	1.64						
	44.0	12	1.%.5	1	DENZE	e-	med-concre	send se	
10	45.5			1			some zeen		
				1		 			
	-		-	1	 	-			
-11	49.0	12	1.5.	1	Very	R-		96	
• •	20.5		//-5	1	Dease	10c	4	134	AR300644
أسيمه	RKS		* 	*************************************					

PROJE LEVA	CT NO ATION: ER LEVI	L DAT	A :.		FIE	TE:! LD GEO	BORING 11/12/87 DRILLER LOGIST: C. Carolcis	۵.	Woodington
					MAT	ERIAL DESCRIPTION*			
SAMPLE NO. & TYPE	DEPTH	8LOWS 6" OR 800 (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS H N
	51								
		20			Ues.				
2-12	54 53.5	25 29			Dense		continue itterit		NO RECOVERY
						î		-	
		20							
3-13	53.0 60.5				DENSE			Sw	Reto ner is being ohere une dem
				Clay			(Based on Oriller		ohermine deva
		8						6,2	-broken in colon
y-12	64.8 65.5	34			nery. Dense		Clayard Sand		end of bore hole
									- last wrench
									down hale
								+	4R300645

PAGE_3_OF_3

PROJI LEVA WATI	CT NO ATION: R LEVE	L DAT	. 27. A:. Ei	٥٥ . سر	FIE	ATE: LD GEO	BORING DRILLER:		wood rates.
-	,		<u> </u>		10 g 25 g	MAT	ERIAL DESCRIPTION*	Τ	
SAMPLE NO. & TYPE	DEPTH (ft.)	BLOWS 6" OR RQD ("4)	RECOVERY RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Death.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
	· ·								
								<u> </u>	
		•					Topsoii	ļ	
	4.0	13			mes		•		
E-1		1	1.36.0		Cente	-00	real : ine sand, w/	sw	00
	50						little arough		
	1								
ڍ-ي	و د	45 45	13/50		Very Cerie	Gray	sond togravel w/	sω	med-fine sand
		52					cathles		76
a v									hitting cobbles al
									10 ++
	٠ ٠٠٠	G:	٠٠%,,		DENSE	Green	Gravel	6W	maist
C - 2	,	14				Rusty Brown	silty sand tamvel	Sw	
	٠,٠,٠		i i				3111 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		30
			, .						
				* * * * *					
	10.0	S.C							
S-4	12.0	= 9	1.2/2.0	1.7	me o ium	Renish			
		G .	7.0		o€n≭	g raw	MED- Course sand,	1200	schusated opp
	21.5			1		<u> </u>	some gravel (weathered	 	
			}	1	 	 -	shale + schist)	-	
		c a	·°/8.5	1	Med	}		-	
ا م ا	540		18.5	1	DENSE	 -	med course sand,	Su	
3.5		74	L	<u> </u>	<u> </u>	<u> </u>	some grant		18386246
REMA	RKS_L	سدناط	~ i em	Auge	•	۶ ''	. c.	_	BORING CR- mail

PROJE LEVA		·•			DA	\TE: : \	BORING 1/4/67 DRILLER DLOGIST: 2. Caresick	: . 🖫	. Woodinkton 🔍
			itions) .	• •					***
		BLOWS	SAMPLE			MAT	ERIAL DESCRIPTION*		
AMPLE NO. TYPE	(ft.)	6" OR ROD ("+)	RECOVERY SAMPLE LENGTH	LIT∺OLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
	26.0								
			•					-	
	20.	7	s.%.0			Red.		-	
10	-9 ^	5	/2.0		bose	8-	med - coarse sand, tr. gravel, tr. silt	126	<u> </u>
	3/.0			T.O.					
	ş			30					
						·		1	
<u>5-7</u>									
-			:					-	
-								1	<u> </u>
								+	
-									
_								1	
							:		
_								_	
	,								AR30064/

PROJE LEVA WATE	CT NO. ATION: R LEVE	L DAT	621Y 67.00 4 . 17.	, , , , , , & ≠	PIE	TE:l. LD GEO	BORING 1.12.187 DRILLER: LOGIST: S-Barnick 1./4.187 1200 Ars	E 2.7.	E1 11,23
			1			MAT	ERIAL DESCRIPTION*	T	1
Sample NO. & Type	DEPTH (ft.)	BLOWS 6" OR ROD (%)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
									•
							gradient de la companya de la compa		
				·			top tall		
	4.0								
5-1		4.	1.36.0	•	DENSE	Tan	med -fine sand , .u/	sw	
	6.8					i	11412 grade		
	-								
-2	3.5	77	10,0		Vense Donse	Brown	50rd + 200 18' W	sw	med-2:Ne sar
		52					isbbles		
-	15				ļ				hitting cabbles
				. 1					
•		<u> </u>	1 0.					<u> </u>	
	14.0	25	1.%		DENSE	Green Fusty	Grant	Gw	maist
:-3		11				Acomo.	sith sand tomvel	<u> </u>	
	16.0								
			1					-	
		32	 	1	ļ			-	
	19.6		1.2/	1	שהי פשש	Pers 30		-	
-4		10 G	1.2/20	1	DENSE.	31000		Sw	SAMATEO
	21.0		}	1			STING SPANIC (SPALL - SCHIT)		
			}			-		-	
	·	29	1.9,	1	med			+-	
5.5	24.0	15	٥.٥/١٠	1	٥٤٥٥٤		med coarse cand	SW	
	L	_lu_		<u></u>	<u> </u>		3m2 3k2 K		18300648

LEVA WATE	CT NO ATION: R LEVE	L DAT	0211		DA	LD GEO	BORING I 12/27 DRILLER: LOGIST: C. Raccick	B.	Wooding tos
						MAT	ERIAL DESCRIPTION*		
Sample NO. & Type	DEPTH (ft.)	810WS 67 OR RQD (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKSHe
	51					lian- Bopun	- to hiel moden	Gir	-sample 5-11
5-11		45	.=/				202536 52i		is traise ve race
		47					hit bedrak 2-55'		אל ים נדייי בי
					4.1	1	- 1 mil - 2 mg : 1 mg - 2 mg - 2		1 pal - 1 - 2 par cale
							ا در ا		
						,.	raicece.		3 100
						٠,	nc 1- 1-c		
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	÷								
•									
				1		4. <u> </u>			
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			7	1					
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					<u> </u>	* * <u>*</u>			
						· .			
]					
			1] .					
			-	1					AR300650
REMA	RKS_								BORING CR.T.

PAGE_1_OF_1

(Date	, Time	& Cond	itions) .							••••••••••••••••••••••••••••••••••••••
		Bromz	SAMPLE			MAT	ERIAL DESCRIPT	ION*		
SAMPLE NO. B TYPE	DEPTH (ft.)	(°-) 400 6-08	RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR		ERIAL ICATION	uscs	REMARKS
	,						_		_Sm	
					-		<u> </u>			
	4.0	3	ود.ع		DENSE	DR TATI	12 w 41:E	ne sand +	300	des
5-1		13					i.Hle ar	2121		
	6 0			-			, ,			
				i			:			7' hitting cobale
								,		
	9.0	103/	s"		VETY		i			
	7.6				02.030	3R	12 42	• • • •		
						•	ul some	Sona	3.17	NO SOME COCONCE
	n.o									11 - 33 - 33 - 33 - 34
			,				303 608	sie s	_	
		32	1.5/2.0		Very	Dark				
	14.0		/3.0		Devise	Brown				
5-2		75					Cobbles, S	ine sand,	G P	-damp
· .	16.0						some si			- 211 deans and
	,				i 		little 3	11+		COPPICS
							· · · · · · · · · · · · · · · · · · ·	+		
	19.0	48 36	٠٠%.6		Very	80		<u> </u>		
5-3		43			OENSE					·
	21.0							<u> </u>	GD	· · · · · · · · · · · · · · · · · · ·
		ļ								
				·				¥Z	_	AR300651

PAGE_L_OF_3

			itions)		I	144-	EDIAL RECEDIATIONS		•••••••••••••••••••••••••••••••••••••••
Sample NO. & Type	DEPTH (ft.)	BLOWS 6" OR ROD ("+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS H N
		65	-413.0			D			
5-5	ચ વ	2000	13.0		DENSE	Dark Grown	dicty - silty soul	<u>5m</u>	sand well sind
	31			.					
		42							
-10	34	13 14 15 15 15 15 15 15 15 15 15 15 15 15 15	ر درو د	·	DENSE	fe2 : i=₹ £2.	city med prived	~~	
\exists	36						Sand little Stant		
-7	39	17 26 19	2.92.0	·	DENSE.	Ret-			wash ougers out
	41						med-coorsege soud	sω	Ditting more
							cottles		cabbles at 40 ft
٠.5	44	27 22	1.2/2.0		DENSE	Brown			
	410		-				some silt, no	2.0	used rotary bit
							graves or cobbles		or visic
				· .				Ĺ-	

PROJE EVA WATE	CT NO ATION: ER LEVE	L DAT			DA	TE:	BORING I ORILLER:	E	Woodington
		BLOWS	SAMPLE	ŀ		MAT	ERIAL DESCRIPTION*		
ro. B Type	DEPTH (ft.)	6" OR RGO ("4)	recovery Sample Length	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
			•			. 6			
	4.7	9	1.3/20		DENSE	ور	red proped Eilty	sm	11/2 84 blow in
-9		20 20					sard	ļ	<i>O</i> 60
	51							<u> </u>	Ste Sand
						``		 	
		ຊວ							
-10	54	7 7 3			DENZE	30	NO SAMPLE RECOVERY	 	used unter to
-		32	·					Sm	معم م المن مدياء
	ع 5					1946 -	isity south	 	avec e
	57	85 LDQ/H	,,		DETISE	@19nn	med-course sand	<u> </u>	
-11-	58	1007		57°			plaw in		57 deilling hard
	59		** · · .				· houlder or bedrock	 	Initing bounders
•							at 57' . Can	 	and cobbles)
							rust deill any deron-	 	58' believed to
									be into bedrock
				1				 	doill pulling hard
				1	ļ			 	
				-				-	
			1	1				-	
	<u> </u>			}				-	
			 	}				 	
	l		1]				 	AR300654

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WATE	R LEVE	L DATA			FIE	LD GEO	BORING 11/5/87 DRILLER LOGIST: P. JONES		
	 					MAT	ERIAL DESCRIPTION*	J	
SAMPLE NO. A TYPE	DEPTH (ft.)	8LOWS 6" OR ROD (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY- CONSISTENCY OR ROCK HARDNESS	ROJOS	MATERIAL CLASSIFICATION	uscs	REMARKS
		X		·				-	
								-	
5-6	29.0 - 30.5		1.4/1.5		NED MASS	77W	MED-COMASE SAND	(SP)	
		8					TRACE GRAVE,	-	
_								-	
<u>5-7</u>	34 o - 35.5	13	0.5/18		MED - DESE	7790	MGO-CLASE SANO	(SP)	
							SOME BEAVEL	igg	
5-8	59.0- 40.5	3	1.5/1.5		Loose	m	MED COMASE SAND	(50-)	
		2			•			lacksquare	
e de la companya de l									
<u>5-9</u>	42.6-	81 85 83	27/1.5		VELY DEASC	flow	MAD-COMESE SAND / FINC -	SP	
	· -	- 65					MAS GRAVEL	GP	
								-	
5-10	420-	8	12 /1.5		IRuse	Mari - MARING	M60-coals Spro		R300657

NATE	R LEVE	L DATA	1				LOGIST: P.JONES		
ample NO. LTYPE	DEPTH (fc.)	BLOWS 6" OR RQD (*+)	Sample Recovery Sample Length	LITHOLOGY CMANGE (Depth/ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
							LAST 6" - WENNERS SEAST		
	. <u>.</u>				·	7			
							en e		
		`							

									<u> </u>
					i v				
									7.4
	-,7,								
					2				and the second
			1						
				i i					
					3.				
				1	1-2				
		 							
		-							
				1				A	R300658

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これれる ひいて	1.1 - 11 .	- 1 -	^	e **	_#	_		/	•	
CIAIWVV7	Hollow	DIEM.	HUGEE		014211	re P	Jaje.	10,0,	_1	
			_				•			

0.16

BORING ER-MWO9 (D

PAGE 2 OF 2

	and the second second	1.00		10.00	- *		
REMARKS Hollow Stee	Ausec		501.4	Socon	Same	ole	
		,	, - •	1			
No HINU	Readings				· ·	<u> </u>	

DENNE

Brown

BORING CR MW10 -0

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* See Legend on Back

1.0/2.0

]							massing	in receivery)		boulder
	•						·			
5-7	34	12								
		5%	۰ ف/ ع. ه	_	Jery Benie	Brown	Gravel + Co	bbler some	aw	Im Biou: + 4"
	36				<u> </u>	Gray Gray		little silt		Grawl - Quarte
	·								-	Cabbles: 30-3 can
							<u> </u>	·		Sanditant.
	39	63	0.5/20		Very Bence					- No large cabbles
5-8		39			<u></u>		Cobbies	w/ fire send	<u>ა</u>	- fairly easy drilling
	41						and si	lt some	-	(1.5 ft of blowin)
						<u> </u>	gravel		-	
						$oxed{oxed}$		·		<u> </u>
	44	19 50	2.0/2.0		7227		med - Sin	Sand +	300	(1.5 ft of blowin)
5-9		96 56			Dense		copples	<u> </u>		hitting boulders
	46						same	•		+cobbles
]			<u> </u>			
	_									
	49	7	1.3/2.0							18t of blamin
5-10		1 <u>9</u>			Dense	4		ν		AR300662
REMA	RKS							•		
										BORING CR MULE
		an Back	-							PAGE 2 OF 3
2.266	regena	on Back				7.		ob organic company		
	٠		•							

VEIALVILLS	
	_

PROJE LEVA	CT NO	 רו	621Y		DA	TE: IC	DOGIST: S. BARNICK	e.	graph of the second control of the second co
							-) 10/87/27 , 2950 n	ಟ.,	
		BLOWS	SAMPLE			MAT	ERIAL DESCRIPTION*		
no. A Type	DEPTH (ft.)	6.04 40D	RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
						81	silty loam to Desocies	2	
	4.0	71 5b	-3/2.0		Very	e.	wit we some fine	WL	moist
<u> </u>		37					sand, to gravel		gravel subrounds
	6.5			<u> </u>	<u>.</u>				to angular
						and the second	-a cavel and small cabbles		The second second
		6.1	5/						
.2	9.0	20	٠٠٤/٥٠٥		DENSE	Brown	cilty sand w/	دس	
		24 24							w 7.5°
	11-0					<u>, `</u> ;	Otzite, Greenschist		Purple Greentich
							and ote cobbles		Gobbles + large
				ngan a sanni					e de la companya de
	14.0	57 68	-8/2.0		Very Dense	Brown	sity sand w/ Cobbles	6w	eobbles are on
•3	1	49				<u> </u>	and gravel		up - Otzite t
	16.0				ļ				Green-chist.
									gravel giz.
				<u> </u>		<u> </u>			11.7. 12.0' AUS A
,	٥٠٥١		1.9%		ven	Green	Croten up cabbles of	Gw	
<u> ૬.</u> .		15"			Dense		Accensist line		nimeld some
	21.0				ļ		in wand and eith		
]			some well rounded		bravel d = 10
		 		1		<u> </u>	Utz Graves		
				1					
J	}	 	1	1	1	i		1	R300665

PAGE OF 3

LEVA VATI	ECT NO ATION: ER LEVI	.: L DATA			DA	ATE: 1.5 ELD GEO	BORING I DRILLER: LOGIST: Cacaca	B	EREMAINSTAN
•				l		MAT	ERIAL DESCRIPTION*	ī	<u> </u>
MPLE NO. TYPE	DEPTH (ft.)	8LOWS 6" OR RQD (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTEMEY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
			·						
		31	-9/2.0			2			
-5	24.0	17	•118.0		Very Dense	Brown Brown	areen scoict, some	GW	-more fines
	24.0		·				so zera ite		and sand
							Mig - 14		
0	£4.5	21	2 %		ひかいて	Brown		_	
	31.5	160					med-CB. Sand -some well rounded	20	- Argula-
							gravel, few Cobble	-	
	340	10	1.%		DENSE WED	Cross	med-cs. sand, little	241	- Augers were
7	36.0	15					eratel , no cobbler		washed ad bear
	÷								taken
.8	39.0	31 37 28 19	ء واره		DENSE	14 % 5000 - Cross Red-	Start, prove tables. Soote Sand, fine sand.	6m	
	41.0		·			Grawn	and - it		
_		i						A	1300666

PROJE LEVA WATE	CT NO ATION: ER LEVE	L DATA	•	· · · · · ·	DA	NTE:	BORING N DRILLER:	Ľ	. มออร เม่าะ:
Sample No. & Type	DEPTH (ft.)	ELOWS E' OR ROD (*4)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Degin.Ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS		MATERIAL CLASSIFICATION	USCS	REMARKS
	-	7				2 R			
	44.0))))			DENSE	Brown			
5-9		27		」目		<u> </u>	Grenschist cobbles,	ઉઝા	
	460					Press.	growl, coarse sand,		
-		·					fine sand and sitt		- starting to bok li
		46	1.6%.0						weathered bedroc
<u>-19</u>	ر ڊ ٽ	25 21	12.0		DENJE	GREEN	Green schist Cobbles,		
		19					some gravel -	GW	
	<u>≎1.0</u>						Conse = ard, some		
							Bilt -clay	-	
		49	.8/		Name of	Greek	silt + gravel		
5-11	54.0	52 48 39	12.0	1.0.	DENSE	Graws	SIL 4 GUSINE		
2-11	56.0			54		Black	weathered schist		mutallic micace
						unite	- Graphitic micaceous		biotite
			 				schist		
			\						
				<u> </u>	146	<u>'</u>			
			 						
]		ļ			
,			 						
ز				<u> </u>					AR300667
REMA	RKS_		·						BORING CR - Man
	-							-	BORING CR. M.

					r		27			
LMPLE NO. TYPE	DEPTH (ft.)	8LOWS 61 OR ROD (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR		TERIAL IFICATION	nzicz	REMARKS
	1.0						SEE CR-MI	12(D) FOR		
							DETAILED	LITHOLOGIC		
				j			DESCRIT	TIONS		
							·	•		
						-				
			·							
						,				
				Q 13.5'						
				1						
				1						
				1						
	23.0			1						
							HOLE COM	PLETED TO 23.0'	12/	50
				1			2"4 PUC M			AR300668

* See Legend on Back

PAGE___OF___

SAMPLE 5-13 EXTENDED HOLE TO 61.0'

PAGE_LOF.

						-	A	TAN	ERIAL DESCRI	PTION*		
AMPLE NO. L TYPE	DEPTH (ft.)-	6.00 800 8.00 810A2	SAMPLE RECOVERY SAMPLE LENGTH	LiTHOLOGY CHANGE (Depth.ft.)	SOI DENS CONSIST GR RO MARDA	JENCA JENCA	CO	LOR		ATERIAL SIFICATION	uscs	REMARKS
-1_	1.0	18			M.DE	NSE	BRO	w.	GRAVEILY S	SAND	SW	DRY HNU-0
		10										
				4.0	•	_	_			<u>, </u>	14	
<u>-2</u>	5.0				V. 100	عد	TA	Ŋ	SILTY FIA	IE SAND	Sm	DAMP HNU-0
		<u> </u>										
										·		
							1.2					
		12		9.6			A P	מעי		<u></u>		·
	10.0	7			M.Del	سجكل	DRA	30€	SAND - SO	ME GRAVEL	Sw	DAMP HNU-O
-3		9					_					GRAVEL-SUB ANGULAR
				}			_	_				SOME RUST CDIORED WAT
										·		on Gravels
		Š					_					
-4	15.0	9		D14.9'			_	_				MOIST HNU-0
		12					<u> </u>	_				
			 -	j			-	-				
	 		 -			_	-			 		
· · ·	 	8		1			-	_				
.5	20.0	12		}		-	-					WET HNU-O
		13		1		_	 -	-				GRAVEL - ROUNDED & 1"
	}		 	1		-		-				
	 		}	1		-						
	25.0		1	24.0		<u></u>	Ľ	<u> </u>		THE GRAINED		WET 111739066

WATE	ER LEVE	L DATA	yden TO 621Y	• • •		DA FIE	TE:	/¿ GEO	1/5/1 LOGIST	37 : Kë	7.N T.	BORING DRILLE McCRE	3 NO.: R: JJ. S FA NO.	CR e~ R	- MWIZ(L)
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,								44.7	CRIAL S	rcen	OTIONS			T	
SAMPLE NO. & TYPE	DEPTH (ft.)	8LOWS 61 OR ROD (*+1	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSI' CONSISTI OR ROI MARDN	CK ENCY	COL		\$	M.	ATERIAL SIFICATION		USCI		REMARKS
5-6	260	12			M.LEN	SE	BRS	ron!	SAN	0			SM	T	
				•			1			1			11		
											,		77	T	
				29.0	1			,	,		•		1		
5- 7	30.0	4			M. STIF	FE	TAT	7.0F	CLAY	- 17	PACE CO	ARSE SANI	CL	0	AMP TO MOIST
		8			1						MicA			T	
1.00			4 4 5	1									Π	T	
														T	
												, ė	11	1	
)	35.0	4											11	1	
5-8		6												1	
			:										\sqcap	T	•
						5					•			T	
5-9	400	5		1							*		Π		
		8													
															-
	2			}								:			
														Ι	
5-10	45.0	8													
		7							<u>. </u>			•			y and was as the second of the second
												:			÷ .
]					·						
]						i i					
5-11	50.0	5								V		1			R300670
- /, :-	50.0 RKS_	5 ▼		<u> </u>		·	L.			↓		: 	_	Дд	R300670 BORING CR-

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* See Legend on Back

* See Legend on Back

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PROJE ROJE .EVA WATE (Date	ECT: ECT NO ATION: ER LEVE , Time	Cro EL DATA & Condi	yden T0 621Y 0-/9 4 - itions)	E	DA FII ت ۲۰۰	ATE: ELD GEO	BORING 12/2/87 DRILLEI DLOGIST: KEUN T McCRE	ino.: C R:W. Sc! Andr	IR-MW13(5)
SAMPLE NO.	DEPTH (ft.)	BLOWS 6" OR ROD	SAMPLE RECOVERY SAMPLE	LITHOLOGY CHANGE		MAT	ERIAL DESCRIPTION* MATERIAL		
& TYPE		('-)	LENGTH	(Desth.ft.)	OR ROCK MARDNESS	COLOR	CLASSIFICATION	uscs	REMARKS
	1.0				1		SEE CR-MW/3(D) FOR		<u> </u>
		1					DETRILED LITHOLOGIC		<u> </u>
							DESCRIPTIONS		
				74.4'				,	
						·			
	15.0								
						, 900	HOIE COMPLETED TO 15.0'	2/2	
			· · ·				2" \$ PVC MONITOR WELL IN	74 7	12/2
							Communication of the Communica		
			2						
			111]		,			
]					
				1					
J				1					AR300672
REMA	RKS D	Rillers	used C	ME 550	w/ 8"6	Horiou	AUGERS TO 15.0'		BORING CR-MUIS

REMARKS DRIVERS USED CME 550 W/ B"& Hollow AUGERS TO 44.0' SAMPLE 5-9 EXTENDED HOLE TO 46.0'

140 16 Hammer, Soll Samm-Samole

* See Legend on Back .

BORING CR-MWI3(D)

PAGE_L_OF_2

WAIE	KLEVE	LUAIA	ficions)			DA FIE	TE:	GEO) 2 87 LOGIST: K	EVIN T.	DRILLER:	₩. ₩.	CR-MW13(D) Se- un of Mathes R
		•				3 6		ITAN	ERIAL DESCR	PTION*			
Sample NO. & Type	DEPTH (fc.)	(1.1) 400 610M2	SAMPLE RECOVERY SAMPLE LENGTH	LiTHOLOGY CHANGE (Depth.ft.)	DE CONS OR	OIL NSITY ISTENCY ROCK DNESS	CO	LOR		ATERIAL SIFICATION		usc	REMARKS
5-5	260	18		25.5	m.	Dense	TA	2	SAND		• 4	5P	WET
			:		M.A	E NSE"	TA	N	SILTY SAN	b - some	CLAY .	Sm	WET
					·								
			7 .							•		Ш	
5-6	30.0			29.7			_3			1		1	
* .		15			M.D	ENSE	380 081	NEE	COARSE SA	ND - Som	SILT	SP	MET HNU-0
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										e de la companya del companya de la companya del companya de la co	. 5	Ц	
				34.0					•	,	· ·	1	
	35.0	5			51	FF.	TATA	NGE	CLAYAND	SAND		CL	MOIST HNU-0
- 7		9//					·		- 501	NE MICA	GRAINS	Ц	
												Ц	
								4 2	ga sa may sa			Ц	
											- 1	Ц	
5-8	40.0	4		40.3	برا		3		<u>'</u>			1	e e e e e e e e e e e e e e e e e e e
		B 14			<u>So</u>	FT		EEN,	DECOMAS	ED SCH	157		DAMP HNU-0
				1			Bu	ex .				L	
										:			
			·										
		B 14]					© a di Hazir				
5-9	46.0	12		46.0	<u>_</u>		L		sala a maga		, <u> </u>		
									HOLE COM	PLETED TO	460' 12	3	
									2" \$ AVC	MONITOR	WELL I	157	TA HED 10/3
]						<u> </u>			
			5 m - 2	;									R300674
<i></i>	RKS_												BORING <u>CR-M</u> PAGE 2 OF

			yden TO				BORING		NUS CORPORATION
PROJE LEVA	CT NO ATION:		621Y . 14.8	0	DA	ATE: ELD GEO	DRILLER	:. C . :	Enga
WATE (Date	R LEVE	L DATA	A:	2°.	13/1/27. . CT. F.14		.c. (7.2/2/27)	1.15	
		BLOWS	SAMPLE			MAT	ERIAL DESCRIPTION*		
ample No. B Type	DEPTH (ft.)	6" OR ROD ("+)	RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS	REMARKS
-1	4	-	1.3/.5		دروا	£6.544	-Dr. Coms occanics		Ciri I
	1.3	5					Fine 11 + 2167 78		•
							300. 106.		
	-12			<u>.</u>			LAC OF US LAND SOM	CL	\$
3-2		3	1.3/1.5	ey week	vert Stiff	Gesar Cesar	V.C.		
•	5.3						•		SATURATED SET
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	ti sa								
	a .o.			·					
زند		74	13/15		STIFE	Brisan	SILT MONT CLAP , THE MICE	n	2 ~
	105	ها	_	2.50			FINE SAND		
	· ·								· · · · · · · · · · · · · · · · · · ·
	14.6								
			1.3/1.5		méd Dévise	ERoum	SKANEL , FINE - MED /	69	
	15.3			TD.			Sant Tord - MED		
				15			?surs-e		
	.74								
	<i>ي</i> . د س								
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·									AR300675
FMA	SK4	ß.				R			
FIAIW		11.	,,,,,,,,	3	can C Auge	<u> </u>	7 (12)	 .	BORING CR. MW

S S S S S S S S S S S S S S S S S S S	1.2/1.5	LITHOLOGY CHANGE (Depth.M.)	DENSITY	COLOR Se.	MATERIAL CLASSIFICATION LEAM, SOME OFFERILS; Sinc sand + sit , tr. Grand Clay withing sand Some grand Some grand	USCS	REMARKS HMY clamp 3 Saturited at 5ft O
(PTH 6-08 RQD (1-1)	1.2/1.5	(Desth.ft.)	DENSITY CONSISTENCY OR ROCK HARDNESS LOOSE VERY STIFF	GRAT ER,	CLASSIFICATION Learn, some organics; Fine sand + sith, to. 20041 Clay withing sand Some gravel		dame of Sft
S	1.3/1.5		VERY STIFF	GRAY BR.	Sinc sand + sit , to. graves Clay willing sand same graves	ME	Saturated at Sft
S	1.3/1.5		STIFF	ĒŖ,	Sinc sand + sit , to. graves Clay willing sand same graves	ME	Saturated at Sft
A 2 3 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1.3%.5		STIFF	ĒŖ,	Clay wisher sand	ML	
S 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1.3%.5		STIFF	ĒŖ,	Clay will sand	ME	
S 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1.3%.5		STIFF	ĒŖ,	same graw!	ME	
.0			STIFF			ML	
.o.			STIFF		Silt some clay, tr.	ML	0
<u> </u>			STIFF		Silt some clay, tr.	ML	
<u> </u>			STIFF	GEOWN	Silt some clay, tr.	ML	
<u> </u>			STIFF	GEOWN	5:14 some clay, tr.	ML	
\$			STIFF	GEOWN	Silt some clay, tr.	ML	
. <u>s</u>							I
	-				Fine Sand	_	
]					
	1	1				1	
<u> </u>	-					1-	
7	0.5/1.5	1	mes			1	
13	1 /1.5	1	oen:	BROWN	Gravel Sine med/some	<u>60</u>	
.5]	┥		 	sand · med coarse		
	1	4		 		<u> </u>	
		.				4	
ه	1]				1_	
12	1.0/1.5		DENZE	BROWN	FINE COARSE SAND	34	
		1					
	1	1				1-	
		1		 		1	
	1	1	 	-		+	
10	1.37	-	MED				*p200676
12	7/1.5		DENSE	BUNN	FINE - CORRSE SAND	56	AR300676
	0 12 02 02 02 02 02 02 02 02 02 02 02 02 02	22 1.0/.5 S 28 S 28 Hollow	0 12 1.0/1.5 S 28 S 13/1.5 Hollow Ster	12 1.0/.5 DEUSE 22 1.0/.5 DEUSE 5 28 DEUSE 13/.5 DEUSE Hollow Stem Aug	DENSE BROWN DENSE BROWN DENSE BROWN DENSE BROWN Hollow Stem Auger	DELY DEUSE BROWN FINE - COARSE SAND TRACE BRAVEL TRACE BRAVEL TRACE BRAVEL TRACE BRAVEL TRACE BRAVEL TRACE BRAVEL	DENSE BROWN FINE CORRSE SAND SW SP TRACE BRAVEL MED DENSE BROWN FINE CORRSE SAND SA Hollow Stem Auger

* See Legend on Back

EMARKS	consisted	well	on 11/10/87	8
				BORING CR-MW1415
_				PAGE 2-0F_2

* See Legend on Back

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- 60	RING	LOG						N	JS CORPORATIO
PROJE PROJE EVA WATE (Date,	CT: CT NO TION: R LEVI	Cro	yden TO 621Y 8.73 A	E	DA FIE	ATE: // ELD GEO	BORIN 1/4/87 DRILLE DLOGIST: P. JONES	GNO: CI	R-MW 15(s)
		ELOWS	SAMPLE				ERIAL DESCRIPTION"		
iample No. & Type	DEPTH (ft.)	6" DR 800 (%)	RECOVERY SAMPLE LENGTH	L:THOLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
			18 (18)				See los for		
							cr-muis(o) for		
							se log for ca-muis(o) for Lithological assurp		
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.EVA	TION:			S	DA	NTE: LD GEO	BORING I 11 / 3 /87 DRILLER: LOGIST: P. Jarres	GRE	66 Acolpason
			<u> </u>	Γ			ERIAL DESCRIPTION*	Ĺ	
AMPLE NO. LTYPE	DEPTH (ft.)-	8LOWS 6" OR ROD (*+)	Sample Recovery Sample Length	L:THQLOGY CHANGE (Depth.ft.)	SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	uscs	REMARKS
	4 .5	10	0.5/15		MEG	GRAY			
5-1	5.5	14	71.5		OFINE	Blunes	FILLE-MIC GRAVEL,	GP	Saturated
							-: It and clay		
	9. 5								
5-2	7		0.16/1.5		RED STIFF	GRE 1 ERSAN	silt - fine sond to	mL.	
	0.5	-4			·		clay		
	14.0	4	0.8/		ni£0			-	
-3	15.5	9	0.8/1.5		DENSE	TAN	NIED FINE SAUC.	SP	
	19.0								
-4	14.0	ر اند	0.75/ /1.s		DENSE	7AU	FINE SAND - SOME	Sm:	-
	20 <u>.</u> S	18			· 		SILT , TR. GRAVEL,	56	# 1 · ·
\dashv							TR. GLAY	41	
;-S	24.n	و	1.27		MED	الأوم) .			AD000670
, a I		1	1.2/1.5	<u> </u>	DENSE	STAN.	Fine - Coarse Sand, Tr.	156	AR300679

PROJE LEV/ WATE	CT NO ATION: ER LEVE	L DATA	 A ,		FIE	LD GEO	BORING I J3/87 DRILLER:	bee	55 Adelphan
(Date	, Time	& Cond	itions) .					T	······································
SAMPLE NO. & TYPE	OEPTH (ft.)	8LOWS 6" OR ROQ (*+)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depin.ft.)	SOIL DENSITY CONSISTENCY OR ROCK MARDNESS		MATERIAL CLASSIFICATION	uscs	REMARKS
	విక్కక	17			i		gravel, sitt + elay		
	<i>39.</i> 6	4	125/			BRONN.			
5-6	G0.5)12 22	1,25/15		Dense	TAN- WHITE	TR. SPANEL +	86	12 30.0 4"
							SILT		Clayer 31H
5-7	34.0 38.5	11	1.4/1.5		very Stiff	GRET WHITE	SILTY CLAT - Some	CL	
	35.5						IN MATRIX	-	
S-8	3 9 .0	ي ا	1.0/1.5			GRAY	HIGHLY WEATHERED		
	40.5	- 2					SCHIST - SOME SILT +CLAY		
:	44.0								
<u>s-9</u>	4≤.5	10	2.15			Grev Grev	WEATHERED SCHIST,		BOTTOM OF HOLE
<i></i>								AR	3006 <u>8</u> 0

* See Legend on Back ·

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AR300681

APPENDIX E

MONITORING WELL CONSTRUCTION FORMS

AR300682



PROJECT Croyden PROJECT NO 621Y ELEVATION 26.00 FIELD GEOLOGIST	BC	CATION Bucks Co., PA PRING CR-MWG(S) ATE W/10/87	DRILLING	
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE CASING:	iPE: ASING: erète	28.49 28.12 2.43 2.66
		RISER PIPE I.D. 2" TYPE OF RISER PIPE: PUC BOREHOLE DIAMETER: 8 TYPE OF BACKFILL: Compa	4 (pentanite	14.06 / /2.0
9.5 <u>\</u> (11-10-87)		TYPE OF SEAL: Benton's — DEPTH TOP OF SAND PACK: — ELEVATION / DEPTH TOP OF SO TYPE OF SCREEN: PUC	e Pellets	10.06/14.0 12.06/14.0
		SLOT SIZE X LENGTH:		- - - - - - - - -
		ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OB WELL:	OF SCREEM R 3 OF SAND PACK: SERVATION	Carried A

BURING	NU		1 1	يسنن



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 26.11 FIELD GEOLOGIST 5 Part	BORING Bucks Co., PA BORING CO., PA DATE 11/4/27	DRILLER E 222 DRILLING METHOD ====================================	
4 -	ELEVATION OF TOP OF SURFA		28.18
GROUND	STICK - UP TOP OF SURFACE C STICK - UP RISER PIPE :	ASING:	2.67 1.52
ELEVATION & A A	TYPE OF SURFACE SEAL:	3r2.6-6	•
	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:		
1 <u>1.15 \(\nabla_1\)</u>	DICCO DIDCI D		
	TYPE OF RISER PIPE:	Surva	
	BOREHOLE DIAMETER:2	••	
	TYPE OF BACKFILL: Cent	c-ineriorie	
	ELEVATION / DEPTH TOP OF S	_	7.89/ 54.0
	TYPE OF SEAL: Bentonit	<u> </u>	na sel - i -
	DEPTH TOP OF SAND PACK:		27.87/56.0
	TYPE OF SCREEN: PYC		31.87/ 58.5
	SLOT SIZE & LENGTH:	•	
	I.D. OF SCREEN:		
	TYPE OF SAND PACK:	an Anaist	
	ELEVATION / DEPTH BOTTON	ARS	00684
	and the second s	· -	٠.
	ELEVATION / DEPTH BOTTON TYPE OF BACKFILL BELOW OF		· 43.81 73.0
i exclusiva	ELEVATION ADERTH OF HOLE		-us.se/ 70.n



PROJECT NO62	1Y BC	OCATION Bucks Co., PA ORING Co., Jona Co., PA ATE 210/87	DRILLER Karl DRILLING METHOD Hav DEVELOPMEN METHOD BX	pozen niger T
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE ELEVATION OF TOP OF RISER PIL STICK - UP TOP OF SURFACE CAS STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	PE: BING:	29.24 28.97 2.34 2.67
		I.D. OF SURFACE CASING: 6" TYPE OF SURFACE CASING: 5 RISER PIPE I.D. 2" TYPE OF RISER PIPE: PYC	leei	
		TYPE OF BACKFILL: Cemm		
		TYPE OF SEAL: Bentonite DEPTH TOP OF SAND PACK:		19.40/ 8.0
1 <u>2.8</u> ((12-7-81)	7	TYPE OF SCREEN: PVC S SLOT SIZE & LENGTH: 0.20 I.D. OF SCREEN: 9"	chyo	14.9 / 12.0
		TYPE OF SAND PACK: clean	102	- ,05685
		ELEVATION / DEPTH BOTTOM C TYPE OF BACKFILL BELOW OBS WELL: NONE	OF SCREEN:R3	<u> </u>
1				2.91 ar.u



PROJECT Croyden TCE PROJECT NO 621Y ELEVATION 27.10 FIELD GEOLOGIST S. & c	BORII DATE	TION Bucks Co., PA NG CR. MWOZ (D) 12/7/87	DRILLING	
	7==	ELEVATION OF TOP OF SURFA ELEVATION OF TOP OF RISER		29.33
GROUND		STICK - UP TOP OF SURFACE C STICK - UP RISER PIPE :	ASING:	
ELEVATION	2	TYPE OF SURFACE SEAL: _Co	nerete	- -
<u>14.4 ▽</u>		I.D. OF SURFACE CASING:G TYPE OF SURFACE CASING:	Steel	• •
(12-9-87)		RISER PIPE I.D. 2" TYPE OF RISER PIPE: PYC	Schua	- -
	★	BOREHOLE DIAMETER: 8'		<u> </u>
		TYPE OF BACKFILL: Benton	ite + lement	• • • • • • • • • • • • • • • • • • •
	4	ELEVATION / DEPTH TOP OF S		<u>-6.9/34</u> .0
5		TYPE OF SEAL:	Y Pellets	-9.9/36.
	-	ELEVATION / DEPTH TOP OF S		-10.1/38.0
		TYPE OF SCREEN: PVC SLOT SIZE x LENGTH: O.2		-
		I.D. OF SCREEN: 2"		<u> </u>
		TYPE OF SAND PACK: <u>Cle</u>	an loarse	
				-
		- ELEVATION / DEPTH BOTTON - ELEVATION / DEPTH BOTTON	AR:	-30.9/48.0 300686
		TYPE OF BACKFILL BELOW O		<u>(</u>
		- ELEVATION / DEPTH OF HOLE	!:	-42.7/70.0



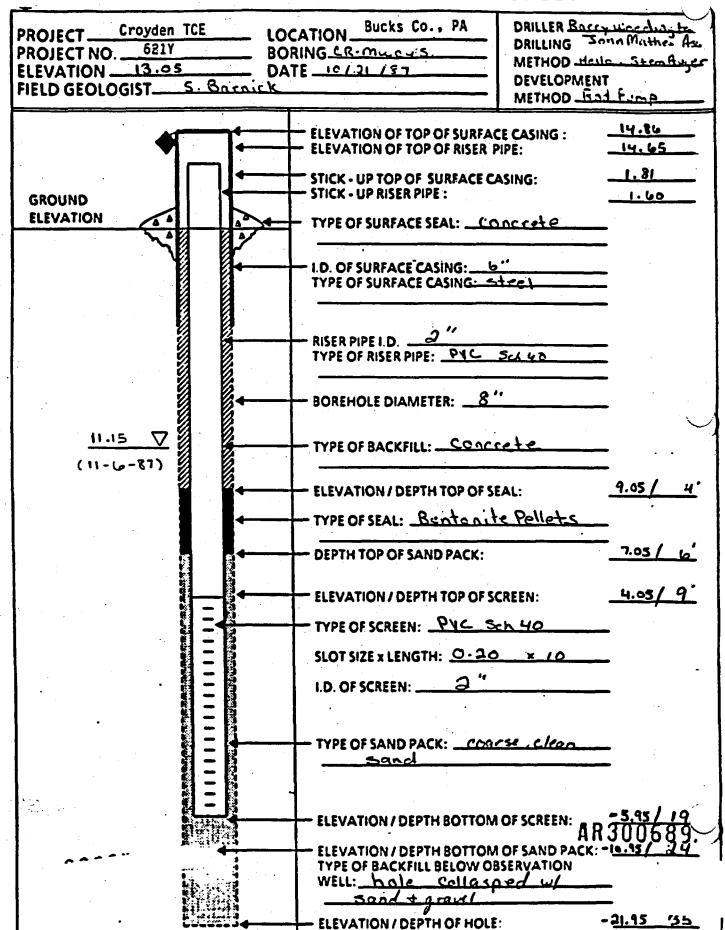
ROJECT <u>Croyden</u> ROJECT NO. <u>621Y</u> LEVATION <u>12.3</u> IELD GEOLOGIST	BO DA	CATION Bucks Co., PA RING F F F ST	DRILLER DRILLING METHOD DEVELOPMEN METHOD F	134 Ger. 1- 5201 17
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE CA STICK - UP TOP OF SURFACE CA STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	IPE: ASING:	14.39 14.10 2.01 1.72
		TYPE OF SURFACE CASING: TYPE OF SURFACE CASING: RISER PIPE I.D.		- - -
<u>11.2 ▽</u>		TYPE OF RISER PIPE: PYC. 5 BOREHOLE DIAMETER: 3'' TYPE OF BACKFILL: Nation	ch 40	<u>-</u>
((2-4-61)		TYPE OF SEAL: Geranal DEPTH TOP OF SAND PACK:		10.32 / = 0 - - - - - - - - - - - - - - - - - - -
•		TYPE OF SCREEN:	en40	<u>8.38/ 4.0</u> -
		TYPE OF SAND PACK: <u>c.lean</u>	. Charle	=
		ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OB WELL:	AR3 OF SAND PAEK:	-163/14.0 00687 -3.12/15.5

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BORING	NO :	 <u>څنين</u>

PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 12.39 FIELD GEOLOGIST	BORING	RILLER 3 F-1- 2 3 P-1- 2 3 P-1
GROUND ELEVATION	ELEVATION OF TOP OF SURFACE CO ELEVATION OF TOP OF RISER PIPE: STICK • UP TOP OF SURFACE CASIN STICK • UP RISER PIPE :	13.98 1.90 1.60
10.93 V (12-4-87)	I.D. OF SURFACE CASING:	
	RISER PIPE I D TYPE OF RISER PIPE: PYC S. BOREHOLE DIAMETER: 8	740
	TYPE OF BACKFILL: Be admite ELEVATION / DEPTH TOP OF SEAL: TYPE OF SEAL: Beaton'te Fe	-\$2.15/ 44.5
	DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF SCREEN	-33.62/46.0 EN: -35.62/48.0
	SLOT SIZE & LENGTH: 0.20 ×	/o ·
	TYPE OF SAND PACK: 2/ean_	
	ELEVATION / DEPTH BOTTOM OF ELEVATION / DEPTH BOTTOM OF TYPE OF BACKFILL BELOW OBSER WELL: Hole plue	SCREEN: AR 300686 SAND PACK: - 43.62/61.2 VATION
	ELEVATION / DEPTH OF HOLE:	-\$2.61/62 U







PROJECT Croyden TCE PROJECT NO 621Y ELEVATION 13.24 FIELD GEOLOGIST 5. Ba	LOCATION Bucks Co., PA BORING C R-MUJOSUDI DATE 10/22/87	DRILLER LECH Harris DRILLING METHOD DEVELOPMENT METHOD Air Lift
GROUND ELEVATION (11-6-87)	ELEVATION OF TOP OF SURFACE ELEVATION OF TOP OF RISER STICK - UP TOP OF SURFACE STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	PIPE:
	- LITH bentonite ELEVATION / DEPTH TOP OF TYPE OF SEAL: _Rentonite DEPTH TOP OF SAND PACK:	e Gro.+
ıŭı	TYPE OF SCREEN: PNC SLOT SIZE x LENGTH: O:	SCREEN: -20.76/84.0
	TYPE OF SAND PACK: _No	tural Aquifer
	ELEVATION / DEPTH BOTTO ELEVATION / DEPTH BOTTO TYPE OF BACKFILL BELOW WELL: Natural Mater	M OF SAND PACK: -36.76/ 50.5 OBSERVATION Al - Hole Callasped



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 29.01 FIELD GEOLOGIST E.C.	LOCATION Bucks Co., PA BORING R	DRILLER E. DRILLING METHOD 113 22 22 22 22 22 22 22 22 22 22 22 22 22
GROUND ELEVATION	ELEVATION OF TOP OF SU ELEVATION OF TOP OF RIS STICK - UP TOP OF SURFA STICK - UP RISER PIPE :	SER PIPE: 31.93 CE CASING: 3.16 2.81
	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING	G''
	RISER PIPE I.D TYPE OF RISER PIPE: BOREHOLE DIAMETER:	
	TYPE OF BACKFILL: Cem	ent bentonite
	TYPE OF SEAL: Cerias DEPTH TOP OF SAND PACE	rite beneas
11.4 ▽ = (12-4-87)	ELEVATION / DEPTH TOP TYPE OF SCREEN: PYC	Schyo
	SLOT SIZE x LENGTH:	
	TYPE OF SAND PACK: ELEVATION / DEPTH BOT	AR 300691
		TOM OF SAND PACK: LOLL DR. A
ؙٷڹۻۿڐ ؙڲۼڛڰ؋ۼڹ _ٳ ۿ	SI SUATION LOCATION	1015: 101 / St. o



ELEVATION OF TOP OF SURFACE CASING: STICK · UP TOP OF SURFACE CASING: STICK · UP RISER PIPE: TYPE OF SURFACE SEAL: TYPE OF SURFACE CASING: TYPE OF SURFACE CASING: TYPE OF RISER PIPE: BOREHOLE DIAMETER: TYPE OF BACKFILL: CPMAN / CHARLES CASING: CAN CHARLES CASING: TYPE OF BACKFILL: CPMAN / CHARLES CASING: CAN CHARLES CA	100 Rad Primp
TYPE OF SEAL: Bentonide Fellowide Fe	2.84 2.84 2.64 2.64
TYPE OF SCREEN:	EN: -AR 37/05.9



PROJECT Cro PROJECT NO ELEVATION FIELD GEOLOGIS	BO	CATION Bucks Co., PA PRING CIG-COMPACE) TE 12/4 27	DRILLING	
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE OF STICK - UP TOP OF SURFACE OF STICK - UP RISER PIPE:	PIPE: ASING:	29.53 27.39 2.53 2.37
	•	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	o'' Nees	• •
	4	TYPE OF RISER PIPE: FYC		- - -
12.17 (11-6-8	4	TYPE OF BACKFILL: CCMACE	AL:	- - -
	-	TYPE OF SEAL: PPRODUCE DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF SO	<u> </u>	95/17.5
	14 T	TYPE OF SCREEN:Slatted SLOT SIZE x LENGTH:QS I.D. OF SCREEN:& ''		- - -
•		TYPE OF SAND PACK: Chear		200693
		ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OB WELL:	OF SAND PACK:	<u> स्छित्रपञ्च .</u>
				_'

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PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 27.06 FIELD GEOLOGIST	LOCATION Bucks Co., PA BORING CO.	DRILLER SANDAL STATE DRILLING METHOD SANDAL STATE DEVELOPMENT METHOD SANDAL STATE METHOD
GROUND ELEVATION	ELEVATION OF TOP OF SURFACE STICK - UP TOP OF SURFACE STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	R PIPE:
11.93 \rightarrow (11-4-87)	RISER PIPE I.D.	54461
	BOREHOLE DIAMETER: TYPE OF BACKFILL:	<i>5</i>
	ELEVATION / DEPTH TOP OF TYPE OF SEAL: Rector DEPTH TOP OF SAND PACK	+< 51011.
	ELEVATION / DEPTH TOP OF TYPE OF SCREEN:	Schro
	TYPE OF SAND PACK: <u>Cle</u>	M OF SCREEN: AR 300 MR Pello
	ELEVATION / DEPTH BOTTO TYPE OF BACKFILL BELOW WELL:	M OF SAND PACK: -24.94/56.6
The second secon	FI EVATION / DEPTH OF HO	11F 34.941



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 30.03 FIELD GEOLOGIST 5.6.25	LOCATION Bucks Co., PA BORING TO MARKET TO A DATE 11/2/87	DRILLER B. Wood
GROUND ELEVATION	STICK - UP TOP OF SURFACE STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	R PIPE: 31.61
	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	
	RISER PIPE I.D. TYPE OF RISER PIPE:	3"
	TYPE OF BACKFILL: ELEVATION / DEPTH TOP OF	FSEAL: 16.03/14.0
	DEPTH TOP OF SAND PACK ELEVATION / DEPTH TOP O	: 14.03/16.6
11.08 ▼ (11-5-87)	TYPE OF SCREEN: PVC SLOT SIZE x LENGTH:O I.D. OF SCREEN:O''	
	TYPE OF SAND PACK: _C\c	UR 300695
	ŧ₿	OM OF SCREEN: A R 3 B 173 95.
	ELEVATION / DEPTH OF HO)LE 2.03/ 00.0



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 29.97 FIELD GEOLOGIST 5.5	BORING F- CALLED	DRILLER E. 11204 02200 DRILLING METHOD TO 112 11 12 12 12 12 12 12 12 12 12 12 12
4	ELEVATION OF TOP OF SURFA	PIPE:
GROUND ELEVATION	STICK • UP TOP OF SURFACE STICK • UP RISER PIPE :	1.94
ELEVATION	TYPE OF SURFACE SEAL:	
<u>11.⊃9 ∇</u>	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	stee!
(11-2-87)	RISER PIPE I.D. 2" TYPE OF RISER PIPE: PNC	Sch 10
		3 "
	TYPE OF BACKFILL:	<u> </u>
	ELEVATION / DEPTH TOP OF	SEAL: -12.03/4=.0
	TYPE OF SEAL: _Egrane	te sixey
	◆ DEPTH TOP OF SAND PACK:	-15.03/ 45.0
	TYPE OF SCREEN:	
	SLOT SIZE x LENGTH:	30 ×/05+
	I.D. OF SCREEN:	
	TYPE OF SAND PACK: Cle	or - Coarse
	ELEVATION / DEPTH BOTTO	M OF SCREEN D 527.0
		MOFSAND PACK: -21.03/ 57.0
	WELL: None	F· "=1.03/57.0



PROJECT Croyde PROJECT NO. 621 ELEVATION 20. 0 FIELD GEOLOGIST	BORIN BORIN	TION Bucks Co., PA	DRILLER Adeiphson Athele DRILLING METHOD MERCON TICE AND DEVELOPMENT METHOD BOAL PUMP	
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE ELEVATION OF TOP OF RISER PI STICK - UP TOP OF SURFACE CA STICK - UP RISER PIPE:	PE: <u>22.81</u> SING: <u>2.37</u>	_ _ _
		1.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	6" 3786L	
		RISER PIPE I.D. 2 TYPE OF RISER PIPE: BOREHOLE DIAMETER:	7+ "	\
		TYPE OF BACKFILL: GROUT AND POINTE AND ELEVATION / DEPTH TOP OF SE	CAMENT	.3'
		TYPE OF SEAL: AENTONITE (PESTRALES DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF SC	12.38 /7.5	
(11-6-87)		TYPE OF SCREEN:	d PVC	
		TYPE OF SAND PACK:		
3(14)		- ELEVATION / DEPTH BOTTOM - ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OB:	OF SAND PACK: -1.32 /2	در <u>د خ</u>
		WELL: <u>NONE</u>	-1.32 /2	>



PROJECT NO621Y	BORIN DATE.	ON Bucks Co., PA G CR-MWR (D) 11/4/87	DRILLING	
		ELEVATION OF TOP OF SURFAI ELEVATION OF TOP OF RISER F		22.90
GROUND ELEVATION	1	TICK - UP TOP OF SURFACE CONTICK - UP RISER PIPE :		<u>2.17</u>
- Call		TYPE OF SURFACE SEAL:	ONCRETE	-
10.20 0		.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	6" Steel	-
(11-6-87)		RISER PIPE I.D.	W	-
		TYPE OF RISER PIPE: <u>Sch</u>		- -
		BOREHOLE DIAMETER:	7 5 *	_
		TYPE OF BACKFILL: _GROUT		<u>E</u>
		ELEVATION / DEPTH TOP OF S		-12.38 /32.9°
		TYPE OF SEAL: BENTON	UITE)	-
		DEPTH TOP OF SAND PACK:		-15.08 /35.6
	- 8	ELEVATION / DEPTH TOP OF S TYPE OF SCREEN:		-15.31 /38.83
	- 19	SLOT SIZE x LENGTH:		- 1
		i.d. of screen:		
		TYPE OF SAND PACK:		-
			A	R 300698
		ELEVATION / DEPTH BOTTOM	•	33.86.848 °
	w. 11. 12. 12. 12. 12. 12. 12. 12. 12. 12	ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OF WELL:	OF SAND PACK: SERVATION	- <u>36.48 /57'</u> -
		ELEVATION / DEPTH OF HOLE	•	-30.42 / 61

BURING	NU.		



	Croyden TCE	LO	CATION Bucks Co., PA	DRILLER _ C2	دديا الاعطادي
PROJECT NO.			ORING 18- (6 :: 19-11)		ilou Sem Asge
LEVATION _	GISTC_E_3		ATE 10 /22 / 27	DEVELOPMEN	1
TELD GEOLO	G131			METHOD _P	UMP (Teal)
		14	ELEVATION OF TOP OF SURFA	CE CASING :	17.96
		 	ELEVATION OF TOP OF RISER I		17.69
			STICK - UP TOP OF SURFACE C	ASING:	1.71
GROUND		{	STICK - UP RISER PIPE :		1.44
ELEVATION	(0)	2	TYPE OF SURFACE SEAL: _co	nerete	-
	~^^I	12			-
		!	I.D. OF SURFACE CASING:		_
			TYPE OF SURFACE CASING:	14221	-
					-
		3	RISER PIPE I.D. G"	·	
			TYPE OF RISER PIPE: PUC	SCHAO	-
					
•			BOREHOLE DIAMETER: _&	· · · · · · · · · · · · · · · · · · ·	-
			TYPE OF BACKFILL:		_
		•	ELEVATION / DEPTH TOP OF S	EAL:	<u> 12.25/ 4</u> .
			TYPE OF SEAL: Bentonite	Periets	_
			DEPTH TOP OF SAND PACK:	•	10.25/ 6.
9.99	▽ [DEPTH TOP OF SAND PACK.		<u></u>
(12-5	-87)	}	ELEVATION / DEPTH TOP OF S	CREEN:	9.25/ 8.0
		<u> </u>	TYPE OF SCREEN:	ch 40	
					-
			SLOT SIZE x LENGTH: 0.20	1044	_
			I.D. OF SCREEN:		
•	7 =			•	
		<u> </u>	TYPE OF SAND PACK: _clea	n -Cogrese.	
			Qte sond		
			1	0	0
	H -	X	ELEMATION (DEDTIL DOTTO)	ME COPER	- 1,75/ io
		3	ELEVATION / DEPTH BOTTOM	лн	300599
	***************************************		ELEVATION / DEPTH BOTTON		<u>-1.75 18.</u>
	kilosa	- 1 - 1 - 1	TYPE OF BACKFILL BELOW OF WELL:	SELANION	_
					<u> </u>
٠.	နားနှင့် ပညာမှုရှိ မြန်မာ့ရ စီမိုးရ			* .	-1.78/ 10



PROJECT Croyden TC PROJECT NO. 621Y ELEVATION 16.33 FIELD GEOLOGIST E	BORING (0)	DRILLER Barry I DRILLING METHOD Balians DEVELOPMENT METHOD Pur	Siem Huger
GROUND ELEVATION 6	ELEVATION OF TOP OF SURFACE STICK - UP TOP OF SURFACE STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	ER PIPE:	18.38 18.06 2.05 1.73
9-95 ∇ (11-5-87)	I.D. OF SURFACE CASING: _ TYPE OF SURFACE CASING.		
	RISER PIPE I.D. TYPE OF RISER PIPE: BOREHOLE DIAMETER:		
	TYPE OF BACKFILL:	OF SEAL:	م. <u>ب د / ۲ ه. د</u>
	ELEVATION / DEPTH TOP CO	OF SCREEN:	0.67/67.0
	SLOT SIZE x LENGTH:Q	•	
	TYPE OF SAND PACK: _C\		<u>::::1/39.</u> 6
	ELEVATION / DEPTH BOTT TYPE OF BACKFILL BELOW WELL:	H N J COM OF SAND PACK: -2 V OBSERVATION	3.67/40.0



PROJECTCroyden PROJECT NO621Y ELEVATION19.1\(\omega\$ FIELD GEOLOGIST	BO	RING Come 1000. TE 10 / 26 / 87	DRILLER Boscy DRILLING METHOD Hello DEVELOPMENT METHOD Air L	mistres vitis.
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE C STICK - UP TOP OF SURFACE C STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	ASING: -	21.30 20.84 2.14 1.68
10.21 ▽ (11-5-87)		— I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	6" Steel	• .
	*	TYPE OF RISER PIPE:	4	
		TYPE OF BACKFILL:Ceme — ELEVATION / DEPTH TOP OF S — TYPE OF SEAL:Rentonite	EAL: • 3	5.84\HZ.0
		DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF S TYPE OF SCREEN: PVC S	CREEN: -1	33.84/ 52.0
• · · · · · · · · · · · · · · · · · · ·		SLOT SIZE x LENGTH:O.2 I.D. OF SCREEN:	···	•
		— ELEVATION / DEPTH BOTTON — ELEVATION / DEPTH BOTTON	ARZ IOFSCREEN:ARZ	833 स्पीलन
		TYPE OF BACKFILL BELOW OF WELL:natural_ a q uise	SSERVATION or material	43.8463.0

BORING NO	
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PROJECT Croyden TCE LOCATION Bucks Co., PA PROJECT NO. 621Y BORING BORING DATE 10 / 29 / RT FIELD GEOLOGIST BACOLK		DRILLER E. DOST. 1-3- DRILLING METHOD TO SU THE	
GROUND ELEVATION	STICK - UP TOP OF SURFACE STICK - UP TOP OF SURFACE STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	PIPE: CASING:	19.69 19.56 1.98 1.85
	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING: RISER PIPE I.D. TYPE OF RISER PIPE: PY	4-e1	
	TYPE OF BACKFILL:	crete	
9.88 🗸 🗀	TYPE OF SEAL: Benton DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF TYPE OF SCREEN: PYC	SCREEN:	
(11-5-87)	SLOT SIZE x LENGTH:O I.D. OF SCREEN:2" TYPE OF SAND PACK:2.1	20 x 10 \$4	-
	ELEVATION / DEPTH BOTTO ELEVATION / DEPTH BOTTO TYPE OF BACKFILL BELOW	M OF SAND PACK OBSERVATION	
	WELL:cle 2 coocs		-0.21/18.0



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 17.42 FIELD GEOLOGIST 5. 8050i	BORING CR. May 11 (D) DATE 10 122127	DRILLER B. Woodsezte DRILLING METHOD Hollow Sten Rote DEVELOPMENT METHOD RAPING Test ELOP
GROUND ELEVATION	ELEVATION OF TOP OF SURFACE OF STICK - UP TOP OF SURFACE OF STICK - UP RISER PIPE : TYPE OF SURFACE SEAL:	PIPE:
10-09 ∇ (10-29-87)	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING: RISER PIPE I.D2" TYPE OF RISER PIPE:PVG	
	BOREHOLE DIAMETER:	•••
	TYPE OF SEAL:	
	TYPE OF SCREEN:PV& SLOT SIZE x LENGTH:O.2 I.D. OF SCREEN:?''	Schyo
	TYPE OF SAND PACK:	
		M OF SCREEN'S U U - 28-32/ 53. M OF SAND PACK: -36-58/ 53. DBSERVATION
الاستادة على المستادة المستاد	ELEVATION / DEPTH OF HOL	E: -36.58/ 54.0



PROJECT Croyden TCE PROJECT NO. 621Y ELEVATION 25.00 FIELD GEOLOGIST KEUN	BORING CR-MUTA(S) DATE 5 DECEMBER 1987 DEVELOPMENT OF STATE OF S	ER W. Seifund ING Hailor Litem OD AUGER OD MENT OD Rod Fime
GROUND	ELEVATION OF TOP OF SURFACE CASING ELEVATION OF TOP OF RISER PIPE: STICK - UP TOP OF SURFACE CASING: STICK - UP RISER PIPE:	G: 27.86 21.57 2.86 2.58
ELEVATION	I.D. OF SURFACE CASING:	AND MIK
	RISER PIPE I.D. 2.0" TYPE OF RISER PIPE: PVC Scu 4	<u> </u>
	TYPE OF BACKFILL: CEMENT & BEN	TONITE
	ELEVATION / DEPTH TOP OF SEAL: TYPE OF SEAL: "PEUTONITE" BENTON!	•
va.58_∇	ELEVATION / DEPTH TOP OF SCREEN: TYPE OF SCREEN: PVC - SCH. 40	13.00/ 10.0'
(12-7-87)	SLOT SIZE × LENGTH: 0.20 × 10	F4:
	TYPE OF SAND PACK: CLEAN- COA	
	ELEVATION / DEPTH BOTTOM OF SAND	DPACK: 2.001 23.0
	WELL: NONE	



ROJECT NO. 62	1Y BC	DCATION Bucks Co., PA DRING SR. M W 12 (E) ATE S DECEMBER REANOR	DRILLER W. SCHIOL DRILLING AUGERIA METHOD AUGERIA DEVELOPMENT METHOD AIC LIFE	ŰG
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE PELEVATION OF TOP OF RISER PIPE: TYPE OF SURFACE SEAL: CEMI	PE:	.56
12.56 ∇		I.D. OF SURFACE CASING: 6 TYPE OF SURFACE CASING: 5	.0"	
(12-19-87)		TYPE OF RISER PIPE:	Sex.40	
		TYPE OF BACKFILL: <u>CEMENT</u> <u>POWDER SIURRY MIX</u> — ELEVATION / DEPTH TOP OF SE TYPE OF SEAL: <u>PELTONITE</u> PELLETS	AL: <u>6.73/</u>	18.0°
		DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF SC TYPE OF SCREEN: PVC = S	REEN: 3.73/	<u>20.0'</u>
		SLOT SIZE x LENGTH: _0.20		1. 1.
		TYPE OF SAND PACK:CLEA SILICA SAND ELEVATION / DEPTH BOTTOM	AR 300 705	£ 31.0
		ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OB WELL: SAND & CUTTING S (AUGER'S SPIN REVERSED) ELEVATION / DEPTH OF HOLE:	OF SAND PACK: -19.27 SERVATION FROM HOLE	· .



PROJECT Croyden TCE PROJECT NO 621Y ELEVATION 20.19 FIELD GEOLOGISTKEUN T. M.	LOCATION Bucks Co., PA BORING CR-MW 13 (5) DATE BLECOMBER 1987 CREANOR	DRILLER W. SCHIND DRILLING HOUS A TREE. METHOD AUGERING DEVELOPMENT METHOD FUM & (TEXI)
GROUND ELEVATION	ELEVATION OF TOP OF SURFACE OF STICK • UP TOP OF SURFACE OF STICK • UP RISER PIPE : TYPE OF SURFACE SEAL: CEN	PIPE: <u>22.88</u>
	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	6.0" STEEL
	RISER PIPE I.D. 2.0" TYPE OF RISER PIPE: PVC BOREHOLE DIAMETER:	
	TYPE OF BACKFILL: CEMENT	
	TYPE OF SEAL: "PELTONITE"	
N4.99 ♥ = ₹	ELEVATION / DEPTH TOP OF STREEM: _PVC -	SCREEN: 16.11/ 4.0
(12-5-87)	SLOT SIZE & LENGTH:O.O.	70 X 10FY.
	TYPE OF SAND PACK: <u>CLEA</u> <u>SILICA SAND</u>	N-COARSE
	ELEVATION / DEPTH BOTTON TYPE OF BACKFILL BELOW O WELL: NONE	MOFSAND PACK: 5.19/ 15.0
	ELEVATION / DEPTH OF HOL	£ 5.19 15.0



PROJECT Croyden PROJECT NO. 621Y ELEVATION 30. FIELD GEOLOGIST K	BC	DEATION Bucks Co., PA DRING CP-MW13(D) ATE 2-3 DECEMBER 1987 PEANOR	METHOD	AUGER
GROUND ELEVATION		ELEVATION OF TOP OF SURFACE CO ELEVATION OF TOP OF RISER F STICK - UP TOP OF SURFACE CO STICK - UP RISER PIPE : TYPE OF SURFACE SEAL: CEMI	PIPE: ASING:	23.02 22.78 2.44 2.20
14.93 ▽ (12-5-87)		TYPE OF SURFACE CASING:		-
		BOREHOLE DIAMETER: TYPE OF BACKFILL: CEMENT,	8"	
		POWNER SIVERY MIX ELEVATION / DEPTH TOP OF SE TYPE OF SEAL: "PELTENITE" A PELLETS DEPTH TOP OF SAND PACK:		4.58/ 16.0°
		TYPE OF SCREEN: PVC-60 SLOT SIZE x LENGTH: 0.20	CH 40	<u>0.58/20.0'</u> —
		TYPE OF SAND PACK: CLEAN		- - 200707
•		ELEVATION / DEPTH BOTTOM TYPE OF BACKFILL BELOW OF WELL: SAND & MATERIAL FROM WAILS OF HOLE ELEVATION / DEPTH OF HOLE	OF SCREEN 3 OF SAND PACE ISERVATION WHICH COURS	(- 20.42/4/.0



PROJECT Croyden TC PROJECT NO. 621Y ELEVATION 14.20 FIELD GEOLOGIST 2	BO!	ATION Bucks Co., PA	DRILLER C: III DRILLING METHOD #4V DEVELOPMEN METHOD	#
GROUND ELEVATION		— ELEVATION OF TOP OF SURFACE PELEVATION OF TOP OF RISER PER STICK - UP TOP OF SURFACE CA — STICK - UP RISER PIPE: TYPE OF SURFACE SEAL:	PE: SING:	17.65 17.45 2.85 2.65
		- I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:		-
		TYPE OF RISER PIPE:	LP.40	- - -
		TYPE OF BACKFILL:		- - (a.80/ 2.0
<u>11.15 ▽</u>		TYPE OF SEAL:		
(13-3-8 ₁)		TYPE OF SCREEN: PNC So SLOT SIZE x LENGTH: 0.20	h40	10.80/40
		TYPE OF SAND PACK:	200116	-
		— ELEVATION / DEPTH BOTTOM — ELEVATION / DEPTH BOTTOM		0.80/ 17.0
		TYPE OF BACKFILL BELOW OB WELL: ELEVATION / DEPTH OF HOLE:	SERVATION	-0.20/ 15.0



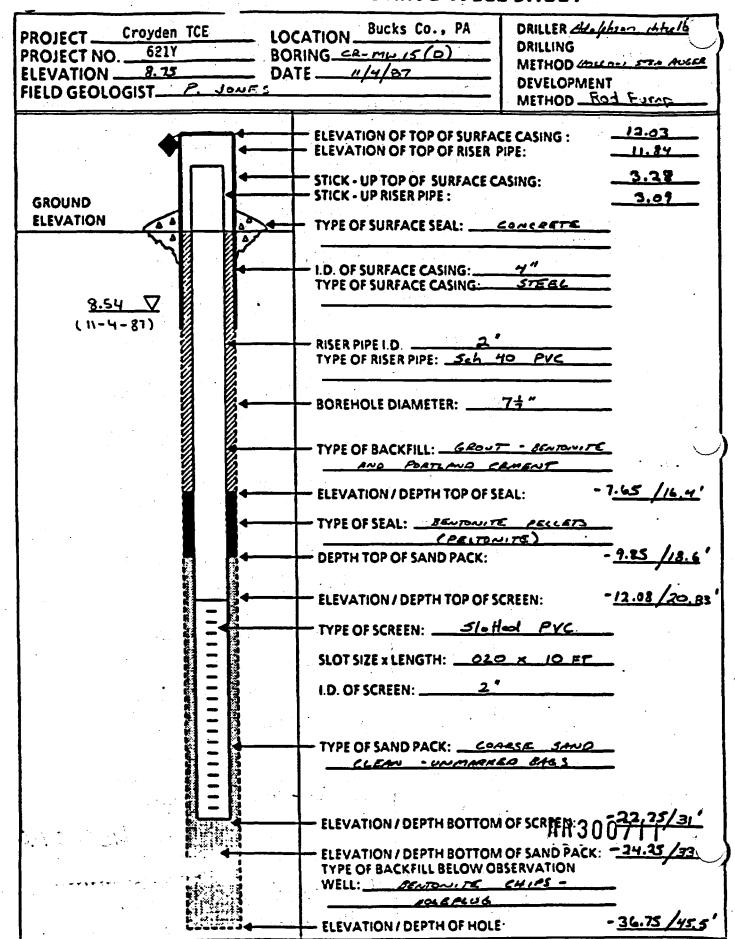
PROJECT Croyden PROJECT NO. 621Y ELEVATION 14.89 FIELD GEOLOGIST	BO	CATION Bucks Co., PA RING CR- MW. 4 (C) TE 11/10/87	DRILLER G Ad DRILLING METHOD Haila DEVELOPMENT METHOD Form	- Stem Auger
GROUND ELEVATION		— ELEVATION OF TOP OF SURFACE POLICY OF TOP OF SURFACE COLORS TOP OF SURFACE COLORS TOP OF SURFACE COLORS TYPE OF SURFACE SEAL:	ASING:	17.39 17.16 2.50 2.21
(11-52-81) 		- I.D. OF SURFACE CASING:(TYPE OF SURFACE CASING: RISER PIPE I.D2* TYPE OF RISER PIPE: P.N.	steel Schun	
		TYPE OF BACKFILL: _Cener	+ / bentanite	2.11 27.0
		TYPE OF SEAL:	CREEN:	15.11 / 30.0 1.11 / 32.0
		SLOT SIZE x LENGTH: 0.20 I.D. OF SCREEN: 2"	×/0′	
		TYPE OF SAND PACK: _Clea Sancl — ELEVATION / DEPTH BOTTOM — ELEVATION / DEPTH BOTTOM	OF SCREEN: AR 3	
		TYPE OF BACKFILL BELOW OF WELL: ELEVATION / DEPTH OF HOLE	SERVATION	27.11 42.0



PROJECT Croyden PROJECT NO. 621Y ELEVATION 8.7 FIELD GEOLOGIST	3	BORING CE-MUIS (S) DATE 11/4/87	DRILLER Adolphio., Hhele DRILLING METHOD Able STEM AUGE DEVELOPMENT METHOD Rod Dump
GROUND		ELEVATION OF TOP OF SURFACE OF STICK - UP TOP OF SURFACE OF STICK - UP RISER PIPE :	PIPE:
ELEVATION		I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	4"
		RISER PIPE I.D. 2 TYPE OF RISER PIPE: 564 BOREHOLE DIAMETER:	., <u>чо рус</u> 74 "
<u>8.37 ∇</u>		TYPE OF BACKFILL: GROUT AND PARTEMED ELEVATION / DEPTH TOP OF S	CEMENT
(11-4-87)	↓	TYPE OF SEAL: BENTON !! (PELTON !! DEPTH TOP OF SAND PACK: ELEVATION / DEPTH TOP OF	5.98 /2.75
		TYPE OF SCREEN:	
		TYPE OF SAND PACK:COCCEON - UNMARKED	-
		TYPE OF BACKFILL BELOW C	M OF SANDRAZO (\$.\$1)/7
		CLEVATION ADDRESS HOLE	· 8.27 /17

BORING NO : CR- MW/5(1





AR300712

APPENDIX F
STATIC WATER LEVEL MEASUREMENTS

PROJECT NAME PROJECT NO. PERSONNEL DATE	CR0+0	nick	COUNT STATE STREE HAP I		raydan Dika iant, DA
PRECIPI	TURE RANG	- NCVE	EQUIPMENT NO EQUIPMENT NA LATEST CALIE	ME	(65 15 74 WATER MARIER 3-25-88
TIDALLS	(-influenc	ED TYES	IXI NO		
WELL OR PIEZOMETER NO.	DATE/ TIME	ELEVATION OF REFERENCE POINT (FEET) •	WATER LEVEL INDICATOR READING (FEET) *	ADJUSTED DEPTH (FEET) •	GROUNDWATER ELEVATION (FEET) *
(R-mucies)	1434	28.12	14.71		13.41
(R-mwoild)	1437	27.63	14.21		13.42
(R-mwezes)	1626	28.97	14.30	<u> </u>	14.67
CR - mux 2(0)	1625	29.04	14.83		14.23
cr-mwates)	1800	14.65	2.59		12.06
(R- MW64 (0)	1765	15.75	3.58		רו. גו
CR-MWCSLS)	1500	3/ 52_	19.54	•	12,28
CR-MWOSID	1503	·3 <i>j</i> · ¥7	19.54		12.33
(R-Mwc4(5)	1445	29.39	16.06		13.33
CR - MWAKED	- 1447	15795 38 32	15.85		13.32
CR - Mwaxs)	1538	19-14-7 se +259	19.47		12.14
CR - MWC7(D)		31.91	19.87		12.04
CR-MWINGS		17.45	5.61		11.84
CR - MU:14(0)	1409	17.16	5.10		12.06
CR-mwis (S)		12.00	3,71		3.29
(R·muis(o)	1706	11.84	رما. 2		9,23
		9			1
CR-18-30	1417	90.92	19.55		11.37
CR-13-55	1421	30.13	19.41		11.52
CR - 19 - 15	1540	11.50	1.63		9.87
CR - 19 - 37	1548	12.27	0.71		ndhsia Li
LF-13-18	1525	19.32	8.58		111300111
LF -13 - 43	1520	18.44	7.08		11.36

AR300714

	PROJECT NAM PROJECT NO. PERSONNEL DATE	1621 7	ensek	COUNT STATE STREE HAP L	Y	re, lua 2 lua PA	,
	PRECIP	DITIONS ATURE RANG ITATION TRIC PRESS	_NCNS	EQUIPMENT NO EQUIPMENT NA LATEST CALIE	ME	651574 WATER MACKER 2-25-18	- -
	TIDALL	Y-Influenc	ED TYPS	IXI NO	e e e e e e e e e e e e e e e e e e e	. V	
~	WELL OR PIEZOMETER NO.	DATE/ TIME	ELEVATION OF REFERENCE POINT (FEET) •	WATER LEVEL INDICATOR READING (FEET) •	ADJUSTED DEPTH (FEET) *	GROUNDWATER ELEVATION (FEET) *	
	(R-25-13	1636	14.04	4.68		9.36	<i>!</i>
	CR-1-22	1637	23.54	13.25	1 1	10.29	}
•	CR-1-50	1640	22.81	12.37		10.44	
	GR-21-27	1719	16 09	5-47		10.62	į
	CR - 21-17	1722	16.18	5.68		10.50	
	LR -21 - 38	1725	15.93	5.17		10.76	•
	5.6 \$1	1658	10.21	2.41	•	7.80	İ
	5.c. #4	1401	10.39	a.41		7.58	
				1		e Per	
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						*	
. *							Ì
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						•	
	·						ł
							-
					A	R300715	
			•			_	

^{*} All elevations to nearest 0.01 feet.

	· · · · · · · · · · · · · · · · · · ·			
PROJECT NAME	Condentie	LOCATION	MUNICIPALITY	-Cardin PA
PROJECT NO.	433, 553 (6.	<u>(</u> /†)	COUNTY	-Eick
PERSONNEL	Segrant	_	STATE	PA
DATE	2-21-80		STREET OR	
			MAP LOCATION	
		•	(IF OFF-SITE)	
			· • · · · · · · · · · · · · · · · · · ·	
•			10 to	· · · · · · · · · · · · · · · · · · ·
WEATHER CONDI	TIONS			
WENDER !	**** DAMES 0-	A - C - MATTER	F110 110	å

WEATHER CON	DERTONG	$\mathcal{A}_{i} = \{ x_{i}, \dots, x_{i-1}, \dots, x_{i-1}, \dots, x_{i-1} \}$	•		
Temper Precip	DITIONS ATURE RANG ITATION TRIC PRESS	A ME	EQUIPMENT NO EQUIPMENT NA LATEST CALIB	ME ·	NICO3
TIDALL	Y-INFLUENC	ED TYES	I NO		
WELL OR PIEZOMETER NO.	DMTE/ TIKE	ELEVATION OF REFERENCE POINT (FEET)*	WATER LEVEL INDICATOR READING (FEET) 4	ADJUSTED DEPTH (FEET) *	GROUNDWATER ELEVATION (FEET) *
1					

PIEZOMETER NO.	DATE/ TIME	REFERENCE POINT (FEET)	Indicator READING (FEET) •	DEPTH (FEET) *	GROUNDWATER ELEVATION (FEET) *
(R-mwoiss)	C903	28-12	12.91		15.21
CR-MUDICO)	0901	27 63	12.46	- 14	15.17
cr-muozes)	1030	28.97	13.97		15.00
CR-MW03(0)	1053	29.06	14.09		14.97
CE - mwo4 (S)	0846	14.65	9.26		12.39
CR-muoyid)	03 4 7	15 75	3.09		12.66
cr-mucscs)	0917	31.92	18.95		12.87
(n-mwcs (b)	0916	31.87	15-97		12.70
CR-MWOOLS)	0911	29.37	15.35		14.04
cr-nucico)	0910	29.17	15.15		14.02
CR-MWOZES)	0935	31.61	18.74		12.87
CR-MWOTED)	0936	31.71	19.08		12.83
(r-mwoses)	0943	22.31	10.74		12.07
(R-muo FID)	0944	22.61	10.59		12.10
fr.mwoses)	0958	17.69	6.33		11.36
CR-MW09(0)	09 59	18.06	6.73		11.33
cr-mwiolal	1004	20.84 4.44	9.11		11.73
LF -14-20	0940	Pec all's	9.40		11.75
CR-MUNCS)	0952	19.50	8.29		11.27
(R-mwille)	0953	19.25	8.00		11.25
CR-Musizes)	1017	27.58	12.83		2443751 6
CR-mwizCO)	1015	26.56	11.72	ŧ	4 - 84
CR-mwi3(5)	1038	22.09	4.92	• 10 mg/s	17.17
CR-mweg(s)	0837	14.10	1.55	100104	12.55
CR - Mw03(0)	0838	13.48	1.44		12.54

PROJECT NAM PROJECT NO. PERSONNEL DATE	:47316 .55	3 (n=/7)	COUNT STATE STREE MAP 1		14 S
PRECIP	ATURE RANG	NINE	EQUIPMENT NO EQUIPMENT NA LATEST CALL	ME	<u>N 11-03</u> <u>IN - 30PE</u>
TIDALL WELL OR PIEZOMETER NO.	Y-INFLUENC DATEZ TIME	ELEVATION OF REFERENCE POINT (FEET)	WATER LEVEL INDICATOR READING	ADJUSTED DEPTH (FEET) *	GROUNDWATER ELEVATION (FEET) *
CR-MUISION	1037	22.78	5.40		17.18
CR-MUNY(S)	0857	17.45	5.31		12.14
CR-MUNY(0)	0155	17.16	4.67		12.49
pr-muis(s)	0817	12.00	3.45		§. 55
CR-muss(D)	0320	11.84 28 3-42	2.35		9:4944 43-8
	3,44	•			
LF 13-43	1512	25 15 13.44 Sectote 7.0 Pre	6.45		11,99
LF-13- 13	1514	19.32	8.10		11.22
LF-15-26	15 32	" 18.15	7.18	. 4	10.97
LF - 15 -37	15 34	., 17.34	6.47		10.87
CR-18-30	16013	30.92	19.11		11.81
CR-13-55	1602	As 30.73	18.87	8	12.00
CR - 19-15	1539	11:50	1.43		10.07
CR-19-37	1533	" (2.12	0.16	:	11.96
cR-23-53	15 40	28.92	15.31		13-61
CR-23-32	1539	29.89	15.30		13.59
CR-24-7	NATION AND ADMINISTRATION OF THE PARTY.	8.37	Could NoT	Find	
CR-24-16		9.39	Los of No		
CR - 25 -13		14.09	Could No-		(Found 3.25.87)
(R - 25 - 34	· · · · · · · · · · · · · · · · · · ·	14.04	Could No+	Find	(Fund 3-25-88)
(R-26-19	1540	15.34	4.18		11.16
CR - 26 - 38		15, 28	3.90	: 1	# K3\$007
CR-27-18	1545	14.52	2.51		12.01
10 - 27 - 38	.545	14 76	2.50		12.25

^{*} All elevations to nearest 0.01 feet.

A measurement from top of Puc.

	PROJECT NAME PROJECT NO. PERSONNEL DATE	621	Y	COUNT STATE STREE HAP I	T OR	of Oon ucas
	Precipi Baromet	ATURE RANG	SURE	EQUIPMENT NO EQUIPMENT NA LATEST CALLE	Me RATION DATE	W- 84 €
	WELL OR PIEZOMETER NO.	DATE/ TIME	ELEVATION OF REFERENCE POINT (FEET) *	WATER LEVEL INDICATOR READING (FEET) *	Adjusted Depth (Feet) *	GROUNDWATER ELEVATION (FEET) *
-	CR-mwo.(5)	1030	29.12	15.32		12.10
	CR-MUCTED)	1025	27.63	14.85		12.78
•	LR-MWCZCS)		28.97			
(43	CR - MUOZID)		29.06			
	CR-mwc3cs)	1125	14.10	3.14		10.96
٠.	CR-mucolo)	1121	13.93	3.25		10.73
	PR-Musy(s)	1144	14.65	3.60		11.05
	CR - mucy (D)	1146	15.75	4.68		11.67
	(R-mucsus)	1105	31.82	20.70		_11.12
	CR-MWOSED)	ط110	31.37	20.68		11.19
	CR-MWOLES)	1045	29.31	17.48		10.91
	(R-murico)	1046	29.17	17.25		11.92
	CR-MWC7(S)	1000	31.61	17.00		16.90
	CR-MWE7(b)	1008	31.91	. 20.98		10.93
	CR-muce(s)	1001	22.11	12.47		10.34
	CR - mu O E(D)	1000	22.69	13.32		16.37
	CR-mwog(S)	0858	17.69	7.89		9.60
•	CR-mw09(0)	0916	13.00	8.26		9.80
• • .	CR-mwioco)	0935	20.34	10.80		10.04
	CR-mwiles	0930	19.56	9.90		9.66
کر . د اهل	CR-MWHO)	0928	19.25	9.61	#. #	9.64
	CR-Muil(S)	0756	27.53	15.17	AR	300.418
` '	CR-MWIZED)	9080	26.56	14.16		12.46

^{*} All elevations to nearest 0.01 feet.

PROJECT NOS PERSONNEL DATE	3. Ra	cnick	CATION MUNICIPALITY CROYDOM COUNTY 8.CK > STATE PA STREET OR HAP LOCATION (IF OFF-SITE)				
PRECIP	ature rand Itation	29°	EQUIPMENT NA LATEST CALL	Dr-3cape 1-4-88			
TIDALL	Y—INFLUEN	CED. TI YES	I NO				
WELL OR PIEZOMETER NO.		ELEVATION OF REFERENCE POINT (FEET)	WATER LEVEL INDICATOR READING (FEET) *	ADJUSTED DEPTH (FEET) •	GROUNDWATE ELEVATION (FEET) *		
(R-mw13(5)		22.09					
(R - MW13(0)		22.78	Lead on a				
CR - mui4 (4)	1200	17.45	20.41		11.04		
(R - MW 14(0)	1205	17.16	6.12		N.cy		
CR-muists)	1230	12.00	3.73		3,27		
CR - MWISCO)	1247	11.34	3-22		8.62		
LF-15-37	0834	17.34	7.91		9.43		
LF -15-26	0835	18.15	8.65		9.50		
ce - 23 - 32	ro53	23.39	17.36		11.53		
CR - 23-53	1056	28.92	17.38		11.54		
LF-14-20	0934	91.15	Han 🌲		10.04		
	Carlo Asserting						
	·\$#.5				•		
Gauge #1	1300	10.21	2.50		7.71		
Coure = 2	1355		3.12.	VANDALIZED			
Gouse #3	1346	6.22	2.50	·	3.72		
				•			
				•			
			144	ΛR	300719		

^{*} All elevations to nearest 0.01 feet...

				•					•		
. بر.	PROJECT NAME		N TLE	COUNT		WNIC	IPALITY _			۱ -	
<i>_</i>	PROJECT NO.	<u> </u>				COUNTY		-BOLKS			
	PERSONNEL DATE	S. BARMER		STATE STATE		STATE STREE	T.OR	2 12 14 1	A POST TO SERVICE		
						KAP L	OCATION	A 1 1 1 1 1	or with	<u>ه </u>	
	· .	1				(IF O	FF-SITE)	•	and the second		

	WEATHER COND	ITIONS TURE RANG	E 10.5	•	EOUI PME	NT NO	is alligned	60.2	ALIPETER.	2 客勤	
	PRECIPI	TATION	TION TO THE STATE OF THE STATE			EQUIPMENT NO. EQUIPMENT NAME LATEST CALIBRATION DATE 1-4-88					
	BAROMET	RIC PRESS	URE	3 63	LATEST 1	CALIE	RATION D	TE _	1-4-88	.	
	TIDALLY	-INFLUENC	ED III Y	ES	L	I NO		11041	Participation (2)		
					WATER LA	FVFI.	5				
	WELL OR		ELEVATION	OF	INDICA!	TOR	ADJUSTE	D GF	OUNDWATE	R	
	PIEZOMETER NO.	TIKE_	REFERENCE PO				DEPTH (FEET) 4		LEVATION (FEET) •		
	CK-MUKE (5)		STEVENS			4	Company of the State of the Sta		ME A SURE	. .	
	CR-mwa(p)	C852	27.63	35 gr j	14.82		A Carlotte Sales	17 12.0	2.81	. Y	
•	PR-mwores)	10 11			16.20			1. 1. 1. 1. 1. 1. 1.	ว์เก	7	
	CR-MUCZIE	1103	29.00		16.3		i, co		12.69	5	
	(R-mw3(s)		Herne Fors	. بری د .	Float	TAN	10,40	in terms	والمراجع أما	4	
البنم	CR-MWC3(D)	0834	13.98		3 .23	Ç.			6.15]:	
	cr-mussis)	0841	14.65		3.50	<i>j</i>	1.100		11.69	3	
	CR-MWCY(P)	0841	15.75		4.71	,		3.4.	แระจ		
	CR-MWDSCS)	0907	31.82		20:6	3	<u> </u>	4 (4)	1.14		
	[R-mwos(D)	0906	131.87		20.6		11.37	(n. 3.7)	1:26	1	
	CR-mwow(S)	0857	29-39	1.34	17.45		1 3 80		1.94		
	CR-MWOVED)	0856	29.17	***	17.2	8			11789	1	
	(R-MWO7(S)	0911	131.61	1) 20 3 0	20.6	2			0.99	E ,	
	(r-mwazia)	0918	31.91	العلائدوال	20.7	3			1:18		
	CR-MUDB(S)	1442	22.81		12.40	2	a market of a	1 lc	<u>ंच</u> ि		
	CR-MUDSID)	1443	22.69		12.20	٥	Charles Control		0143		
	CR-MWOG(S)	: المارين المارين الماري	STEVENS R	Ecok	ER					1	
	(R-MW09(D)	····	STETENS!	CE CORD	EN.	est. Vijast					
•	CR-MW10101	0944	ac .84	. J.	10-7	2_			0:12		
	CR-MWH(S)	0918	19.56		9.81		E. H. Willey .		9.75		
	PR-MULLOD	0917	19.25	د پر رهندس	= 9.49	a a Service	and the second		9.76	1	
. .	MR-MWZCS)	·	STEVENS -	re cin	OER.	· •	and such as	1H30	0720	1	
سبر	[ck-mwizzo]	0953	26.50	. Li	14.03	3 l	e seine se sesse		12.53		

^{*} All elevations to nearest 0.01 feet.

groundwater level measurement sheet

PROJECT HAM PROJECT NO. PERSONNEL DATE	6214 3.8AR	NICE	COUNT STATE STREE	T OR	PA PA
	ATURE RANG		(IF C	17	
	ITATION TRIC PRESS		EQUIPMENT NA LATEST CALIE	RATION DATE	1-4-11
	Y-Influenc		MATER LEVEL		:
WELL OR PIEZOMETER NO.		ELEVATION OF REFERENCE POINT (FEET)		ADJUSTED DEPTH (FEET) *	GROUNDWATER ELEVATION (FEET) *
CR-MWINS	1205	. 22.07	7.62		14.47
CR - MWISO)	1206	22.78	8.28		14.50
CR-MW.4(S)	0846	1545	10.39		11.00
CR-MWINCO)	1 4 4 4	1706	6:13		11.07
CR-muisis)		STEVENS RECO	1		
(2-mw15(b)		建设设计划的 化聚苯酚	CORDER	At 1	
LF-15-37	0924	17.34	7.83		٦٠5١
LE HS - 26	0924	18.15	8.53		9.62
06-03-32	0902	28.39	17.29		11.60
(r. 23-53	0900	23.32	17.36		11.56
LF-14-20	. 0946	Sec.	11.07		
CR-26-19	~ 0932	15.34	5.50	***	9.84
(n-36 39		TOCK MON'D NOT	ofen		·
		有人的 有人,			
GAUGE FI	1410	10.21	2.48		٦.13
GAUGE #2	1350	VANDACITED	3.31		
GAUGE #3	1358	6.32	2.37	:	3.35
The high the state of the state		W. State of the Control of the Contr	Andrew Control		•
Carlo propried		A STANDARD CONTRACTOR OF THE STANDARD CONTRACTOR			Lagar Wi
· 医克里克斯斯氏			•		HR306 C
· 中国 · 图·	Contraction rains				

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^{*} All elevations to nearest 0.01 feet.